

FISHERY DATA SERIES NO. 90-22

ANGLER-EFFORT AND HARVEST OF CHINOOK SALMON  
AND COHO SALMON BY THE RECREATIONAL  
FISHERIES IN THE LOWER KENAI RIVER, 1989<sup>1</sup>

By

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## ABSTRACT

A creel survey was conducted on the Kenai River between the outlet of Skilak Lake and Cook Inlet from 16 May through 30 September 1989. The recreational fishery in this section of the Kenai River is directed primarily for two species, chinook salmon *Oncorhynchus tshawytscha* during June and July, and coho salmon *Oncorhynchus kisutch* during August and September. The estimated angler-effort and harvest during the early (May and June) chinook salmon run were 234,527 angler-hours and 7,256 chinook salmon, respectively. The estimated angler-effort and harvest during the late (July) chinook salmon run were 329,051 angler-hours and 9,127 chinook salmon, respectively. Unguided anglers exerted 64.5 percent of the total effort and took 35.1 percent of the chinook salmon harvest, while guided anglers exerted 35.5 percent of the effort and harvested 64.9 percent of the chinook salmon.

The estimated angler-effort and harvest during the coho salmon fishery (August and September) were 252,493 angler-hours and 43,401 coho salmon, respectively. Unguided anglers exerted 76.8 percent of the total effort and took 72.4 percent of the coho salmon harvest while guided anglers exerted 23.2 percent of the effort and harvested 27.6 percent of the coho salmon.

Harvest and catch estimates for sockeye salmon *Oncorhynchus nerka*, rainbow trout *Oncorhynchus mykiss*, and Dolly Varden *Salvelinus malma* are also presented.

KEY WORDS: Kenai River, chinook salmon, coho salmon, creel survey, effort, harvest, sockeye salmon, rainbow trout, Dolly Varden.

## INTRODUCTION

The largest freshwater recreational fishery in Alaska occurs in the Kenai River which received an average of nearly 240,000 angler-days of effort over the years 1983-1988 (Mills 1984-1989). This represents approximately 15% of the State's recreational fishing effort. The majority of the angler-effort occurs in the section of the river between the outlet of Skilak Lake and Cook Inlet (Figure 1) during a fishery directed primarily at returning chinook salmon *Oncorhynchus tshawytscha* during May, June, and July; and a second fishery directed primarily at returning coho salmon *O. kisutch* during August and September. Angler-effort in both fisheries has generally been increasing since creel surveys for these fisheries were begun in 1977 (Figure 2). Sockeye salmon *O. nerka*, pink salmon *O. gorbuscha*, Dolly Varden *Salvelinus malma*, and rainbow trout *O. mykiss* are also harvested by anglers in the Kenai River.

Prior to 1970, the recreational fishery in the Kenai River was confined to shore-based anglers targeting on sockeye salmon in July and coho salmon in August and early September. In 1973, large numbers of anglers began experimenting with a new fishing method that involved bouncing brightly colored terminal gear along the river bottom from a drifting boat. This technique had been used effectively by anglers fishing for chinook salmon on rivers in the Pacific Northwest. It proved very effective for chinook salmon on the Kenai River, and the fishery began to expand rapidly.

The chinook salmon return to the Kenai River has two distinct components: (1) an early run which typically enters the river from mid-May until late June, and (2) a late run which typically enters the river from late June through early August. There is some overlap between the two runs which is not estimated at this time. Fish from both runs are prized by recreational anglers due to their large size, especially those from the late run which average about 18 kg (40 lbs) and may exceed 36 kg (80 lbs). The world record sport-caught chinook salmon was taken from the Kenai River in 1985; it weighed 44.1 kg (97 lbs).

The coho salmon return to the Kenai River also has two distinct components: an early run which typically peaks in August, and a late run which typically peaks in September. The late run continues to enter the river into November but fishing effort after September is minimal.

Management of these recreational fisheries in the Kenai River is complicated by the relatively large commercial harvests of returning chinook and coho salmon. Chinook salmon are commercially harvested primarily by the set net fishery along the eastern shore of Cook Inlet (McBride et al. 1985), and coho salmon are commercially harvested primarily by the drift gill net fishery. User-group conflicts have necessitated that the Department of Fish and Game conduct increasingly precise management of the salmon resources of the Kenai River. During the winter of 1988, the Alaska Board of Fisheries adopted management plans for both the early and late chinook salmon runs. These plans define escapement goals and mechanisms by which the various fisheries are to be regulated to achieve the stated goals. Another component of these plans defines the separation date between the two runs as 1 July.

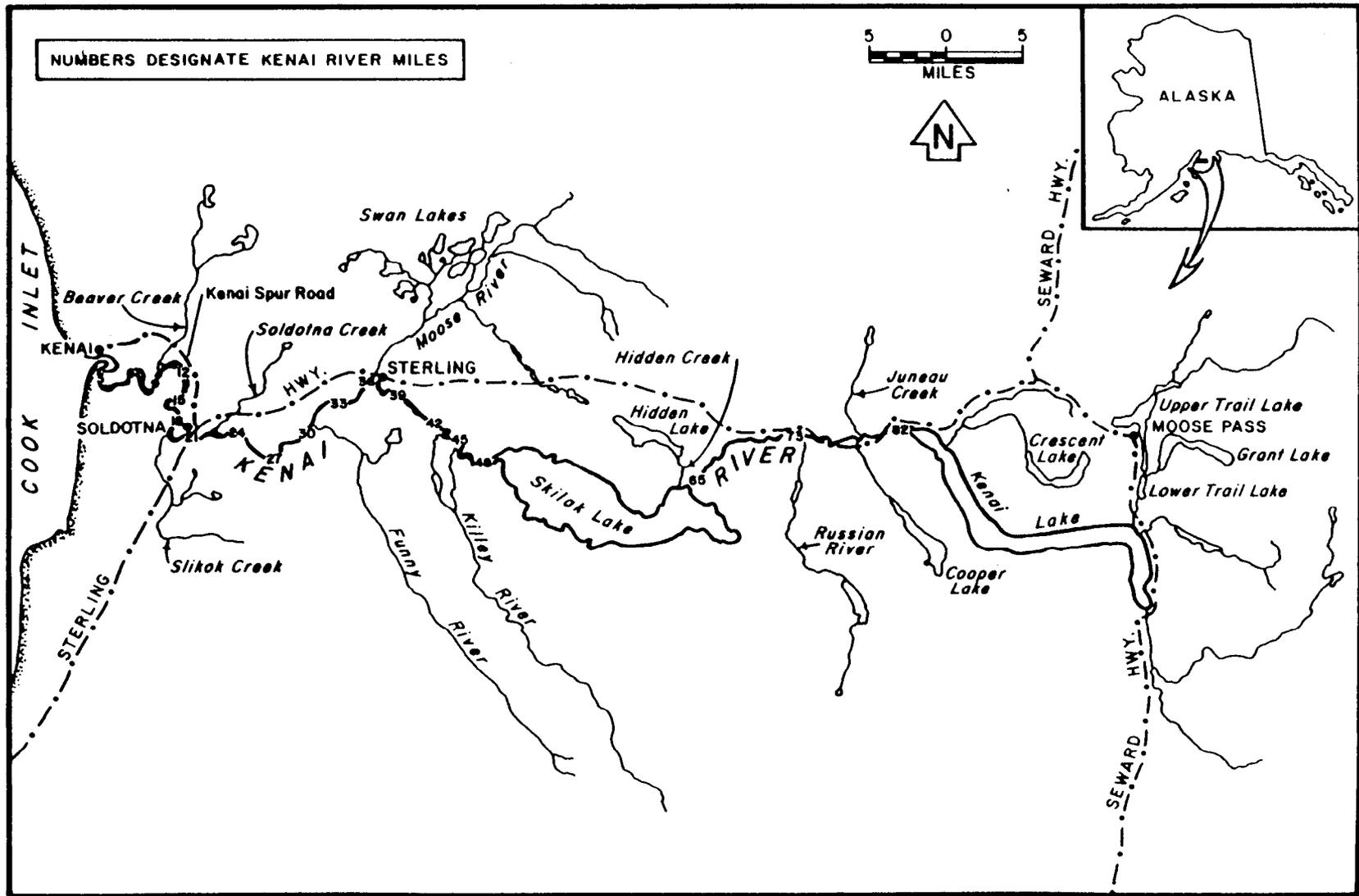


Figure 1. Map of the Kenai River drainage.

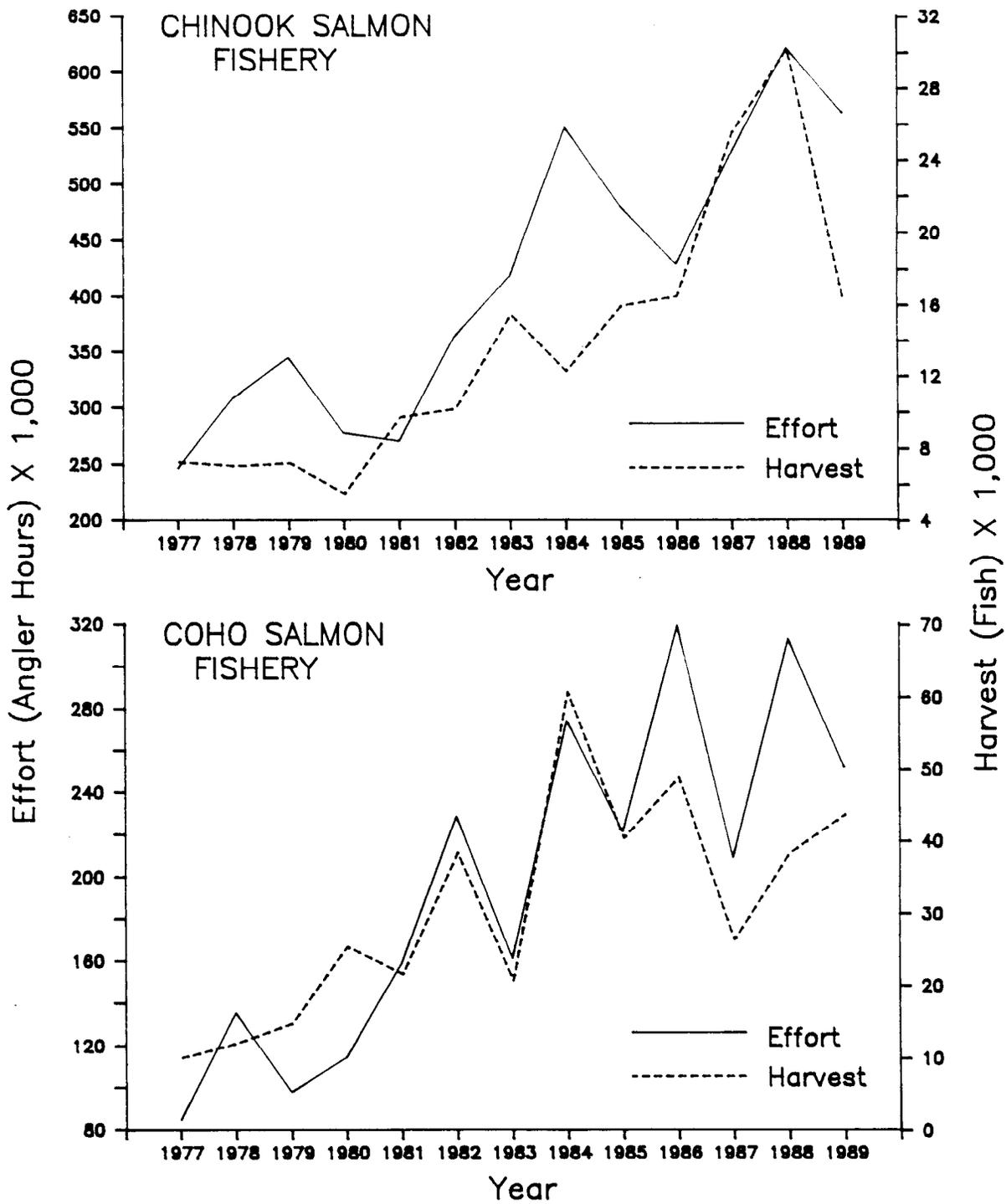


Figure 2. Creel survey estimates of effort and harvest by the recreational fisheries for chinook and coho salmon in the Kenai River, 1977-1989.

Previous information pertaining to the chinook and coho salmon fisheries in the Kenai River has been presented by Hammarstrom (1975-1981, 1988, 1989), Hammarstrom and Larson (1982-1984, 1986), Hammarstrom et al. (1985), and Conrad and Hammarstrom (1987). In addition, angler-effort and harvest by species for the recreational fishery has been estimated by Mills (1979-1989) in the Alaska Statewide Harvest Survey.

The current creel survey program in the Kenai River provides data which are used as a basis for in-season management decisions for the recreational fishery, are evaluated to refine long-term management objectives, and are used by the Alaska Board of Fisheries to allocate the salmon resources. The objective of this report is to present detailed information for the creel surveys of the recreational fisheries for chinook salmon and coho salmon conducted in 1989.

### Fishing Regulations

The regulations for the chinook salmon fishery in the Kenai River are the most restrictive of any open waters in Alaska. Only the section of the river between the outlet of Skilak Lake and Cook Inlet (Figure 3) is open to fishing for chinook salmon. By regulation, the season for chinook salmon is from 1 January through 31 July, but it effectively begins in mid-May when the fish first begin entering the river. The daily bag and possession limits are one chinook salmon per day greater than 41 cm (16 in) in length and a seasonal limit of two chinook salmon greater than 41 cm. In 1989, fishing from boats downstream from the outlet of Skilak Lake was prohibited on Mondays in May, June, and July, except Monday of Memorial Day. Anyone retaining a chinook salmon that is 41 cm in length or greater is prohibited from fishing from a boat in the Kenai River for the remainder of that day. Additionally, the use of artificial lures is permitted until the Department is able to project an escapement of at least 9,000 fish, or 1 July, whichever occurs first.

According to Alaska Statute, regulations adopted by the Board of Fisheries cannot become effective until 30 days after they are signed by the Lieutenant Governor. Although the Board's actions were widely publicized and the regulation booklets had been distributed, the Lieutenant Governor did not sign the regulations until 9 May; thus these regulations could not be enforced until 10 June. This oversight was not discovered until late May. The effect was a fishery that used artificial lures until 1 June, bait until 10 June, artificial lures until 20 June (the date on which the escapement goal of 9,000 was projected), and bait through the remainder of the season.

There are further restrictions for guided anglers. In addition to the closure to fishing from boats on Mondays, fishing from a registered guide vessel on any Sunday in July is prohibited. In 1989, fishing from a guided boat was allowed only between 0600 and 1800 hours during June and July. There are no days or hours closed to boat fishing for either guided or unguided anglers during the remainder of the year.

The daily bag and possession limits for sockeye and coho salmon are an aggregate of three fish that are 41 cm in length or greater, and there is no annual limit. However, if an escapement of 700,000 sockeye salmon is

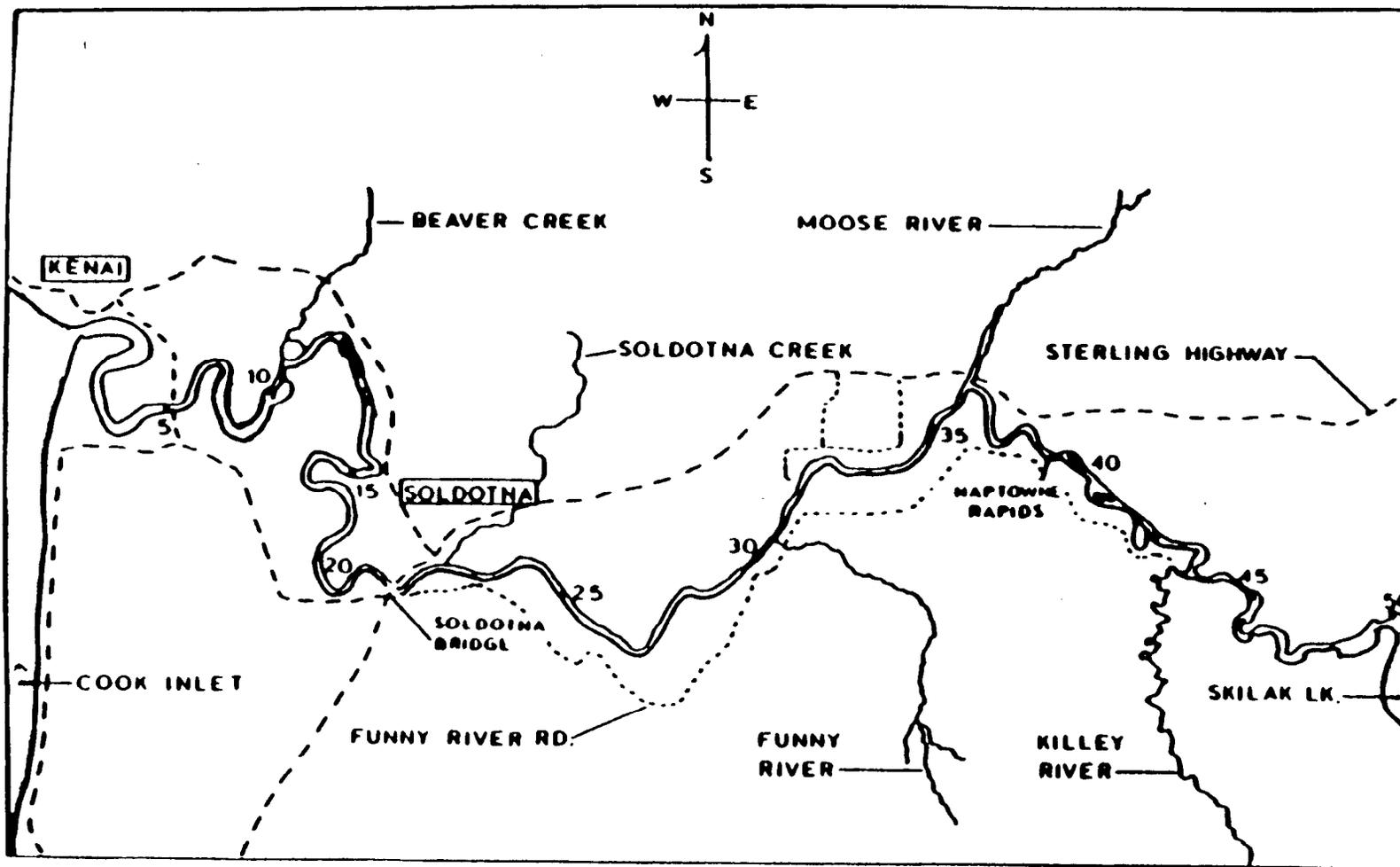


Figure 3. Map of the lower Kenai River between Cook Inlet and the outlet of Skilak Lake (numbers designate Kenai River miles).

realized, the daily bag and possession limit for sockeye and coho salmon increases to six; not more than three of which may be coho salmon. The daily bag and possession limit for pink salmon is six fish that are 41 cm in length or greater, and there is no annual limit. The daily bag and possession limits for rainbow trout are two fish, only one of which may be over 51 cm (20 in) in length, and there is an annual limit of two fish over 51 cm. The daily bag and possession limits for Dolly Varden are five fish.

## METHODS

A roving creel survey (Neuhold and Lu 1957) was used to estimate sport fishing effort, in units of angler-hours, by the fisheries for chinook and coho salmon in the Kenai River. Harvest per unit effort (HPUE, number of fish harvested per hour fished) and catch per unit of effort (CPUE) for each species was estimated from angler interviews. Harvest of each species was estimated by the product of the effort and harvest rate estimates. Angler-effort was estimated for three sections of the Kenai River below Skilak Lake (Figure 3): (1) downstream, from Cook Inlet (river kilometer or river mile 0) to the Soldotna Bridge (rkm 34 or rm 21); (2) midstream, from the Soldotna bridge to Naptowne Rapids (rkm 63.5 or rm 39.5); and (3) upstream, from Naptowne Rapids to the outlet of Skilak Lake (rkm 80.4 or rm 50). These stratifications were selected because of the distance involved and effort patterns observed over the years. Effort, harvest and catch were estimated separately for the early and late run components of the fisheries for chinook and coho salmon.

Both unguided and guided anglers participate in the fisheries for chinook and coho salmon in the Kenai River. These two groups have very different harvest rates; therefore, effort, HPUE, CPUE, harvest and catch were estimated separately for unguided anglers and guided anglers. Guided anglers fish strictly from boats and are easily recognized because guided boats are required to display a large identifying decal. Only boat anglers were surveyed during the chinook salmon fishery because shore anglers harvest very few chinook salmon. During the coho salmon fishery, both boat and shore anglers were surveyed.

### Creel Survey of the Chinook Salmon Fishery

The creel surveys of the chinook salmon fishery began on 16 May in the downstream section and on 11 June in the upstream section and continued until the end of the chinook salmon season on 31 July. The fishing day for unguided anglers was defined as 20 hours long, from 0400 to 2400 hours, and was stratified into five, 4-hour daily time strata (referred to as periods). The periods were: A, from 0400 to 0759; B, from 0800 to 1159; C, from 1200 to 1559; D, from 1600 to 1959; and E, from 2000 to 2359. In May, the stratification of the fishing day for guided anglers was the same as that for unguided anglers. Since most guides schedule two trips per day, one in the morning and one in the afternoon, the fishing day of guided anglers in June and July was stratified into only two periods: A, from 0600 to 1159; and B, from 1200 to 1759.

In the downstream section, estimates for both guided and unguided anglers in each run were stratified into temporal units; Early run, unit 1 (16 May-31 May), unit 2 (1 June-16 June), and unit 3 (17 June-30 June); Late run, unit 4 (1 July-16 July) and unit 5 (17 July-31 July). Estimates for unguided anglers were stratified further by weekdays and weekends/holidays. Estimates for guided anglers were not similarly stratified because this does not significantly reduce the variance of the effort estimates nor the estimates for CPUE and HPUE (Conrad and Hammarstrom 1987).

#### Angler Counts:

A lattice sample design was incorporated into a stratified random sample (Yates 1981) to ensure that angler counts were never conducted in two consecutive periods during the same day or in the same period on two consecutive days for the weekday component of the survey of unguided anglers. This modification was designed to minimize the autocorrelation between counts (Conrad and Hammarstrom 1987). Some deviation from the schedule did occur because of mechanical breakdown and/or other duties such as public assistance or enforcement activities.

Separate sampling schedules for angler counts were established for the downstream and upstream sections of the river. Sampling levels were designed to estimate catch and harvest within 15% of the true value 95% of the time. The creel survey in the downstream section employed two creel survey clerks, each working 37.5 hours per week. The creel survey in the upstream section employed one creel survey clerk working 37.5 hours per week.

Counts of anglers were conducted from a boat in the downstream and upstream sections of the Kenai River. At the time designated on the schedule, a creel survey clerk was at a randomly selected end of the section of the river to be surveyed. The angler count was made while the boat was driven at a constant rate of speed through the survey area to the opposite end of the river section. This trip usually took about 45 minutes and every effort was made to ensure that the trip was completed in less than 1 hour. Angler counts were considered to be instantaneous and to reflect fishing effort at the time of the count. During the angler count, the creel survey clerk recorded the following: (1) total number of unguided boats, (2) total number of guided boats, (3) total number of anglers in unguided boats, (4) total number of anglers in guided boats, and (5) total number of shore anglers. Boats were considered to be engaged in fishing and were counted if they were in operation, as opposed to tied to the shore, regardless of whether or not an angler's line was in the water when the count was being conducted. Guides were not included in the counts during the chinook salmon fishery as they are prohibited from fishing while guiding.

Downstream Section. There were two possible sampling patterns for the counts of unguided anglers during weekdays (Figure 4), one of which was randomly selected each week. Within a period (A, B, C, etc.) to be sampled, a starting time for the angler count was randomly selected from the four whole-hour times-(for example, 0400, 0500, 0600, or 0700 for period A) in the period. Succeeding counts were made 8 hours later.

PATTERN ONE

<u>DAY</u>	<u>PERIOD</u>				
	<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>	<u>E</u>
TUE	0400		1200		2000
	0500		1300		2100
	0600		1400		2200
	0700		1500		2300
WED		0800		1600	
		0900		1700	
		1000		1800	
		1100		1900	
THU	0400		1200		2000
	0500		1300		2100
	0600		1400		2200
	0700		1500		2300
FRI		0800		1600	
		0900		1700	
		1000		1800	
		1100		1900	

PATTERN TWO

<u>DAY</u>	<u>PERIOD</u>				
	<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>	<u>E</u>
TUE		0800		1600	
		0900		1700	
		1000		1800	
		1100		1900	
WED	0400		1200		2000
	0500		1300		2100
	0600		1400		2200
	0700		1500		2300
THU		0800		1600	
		0900		1700	
		1000		1800	
		1100		1900	
FRI	0400		1200		2000
	0500		1300		2100
	0600		1400		2200
	0700		1500		2300

Figure 4. Two possible lattice sampling patterns for counts of unguided anglers during weekdays of the Kenai River chinook salmon fishery, 1989.

For unguided anglers during weekend/holidays, an angler count was made during each period of each day. During weekend/holidays, a starting time was randomly selected for the count in period A and counts in all subsequent periods began 4 hours after the starting time of the previous count. This systematic design was used to allow estimation of the autocorrelation between angler counts conducted on the same day.

During May, guided and unguided anglers were counted according to the same schedule. During June and July, one count of guided anglers was made during each of the two daily periods defined for guided anglers on each day the fishery was open to guided anglers. The count schedule for guided anglers was established by overlaying the schedule for unguided anglers and randomly selecting a count time for those periods of the guided angler day when a count of unguided anglers was not being conducted.

Upstream Section. Angler counts were scheduled for each weekend/holiday day and on 3 randomly selected weekdays each week in the upstream section. On a sample day, two periods (A, B, C, etc.) were randomly selected without replacement and a starting time for the angler count designated as described for the creel survey of unguided anglers during weekdays in the downstream section.

Midstream Section. Three aerial surveys of the river between Skilak Lake and Cook Inlet were scheduled each week, one on a weekend and two during weekdays. During the flight, a count of each boat actively engaged in fishing was recorded for each section of the river. The boat counts were used to estimate the proportion of fishing effort occurring in the midstream section of the river.

#### Angler Interviews:

Interviews of completed trip anglers for harvest and catch rate information were conducted primarily at seven popular boat landings in the downstream section. Information gathered in 1987 (Hammarstrom 1988) showed no significant difference between anglers using the seven campgrounds and other areas, thus only those seven sites were sampled. In the upstream section, both completed trip and incompletd trip anglers were contacted throughout the area open to fishing. No interviews were conducted in the midstream section.

Two creel survey clerks conducted the interviews at the boat landings. Each clerk was scheduled to work 5 days each week; on each weekend/holiday day and on 3 randomly selected weekdays. Two randomly selected landings were sampled by a clerk on a sample day. Thus on weekend/holidays, four landings were sampled each day and on weekdays either two or four landings were sampled. The starting time for the 7.5-hour interview period was randomly selected from either an early shift (possible start times: 0600, 0630, 0700, or 0730) or a late shift (possible start times: 1500, 1530, 1600, or 1630). The creel survey clerks conducted interviews for about 3.5 hours at each landing. The two landings frequented by guided anglers were sampled primarily around 1200 hr or early evening hours to correspond with the times guides normally end a fishing trip. When the clerks responsible for angler counts were not conducting a count, they contacted incompletd trip anglers searching for

tagged and untagged fish in an angler's creel that could be used as part of an abundance study being conducted concurrently. In the upstream section, the creel clerk contacted incompleting trip anglers during any time of the shift when not conducting angler counts.

The following information was recorded for each angler interviewed: (1) completed trip or incompleting trip angler, (2) guided or unguided angler, (3) number of hours spent fishing (defined as time spent in the boat), (4) number and species of fish retained, (5) number and species of fish released, and (6) docking location. Additional information regarding the presence of tags was also recorded as part of the recovery effort in the project to estimate the escapement of chinook salmon into the Kenai River (Alexandersdottir and Marsh in preparation).

Chinook salmon observed in anglers' creels during the surveys were randomly selected for biological sampling. Mid-eye to fork-of-tail length was measured to the nearest 0.5 centimeter, the sex of the fish was identified, and scales were removed from the preferred area (Clutter and Whitesel 1956). Three scales were collected from each fish and placed on an adhesive-coated card. Impressions of scale cards were made on acetate and scale images were examined using a microfiche reader.

#### Creel Survey of the Coho Salmon Fishery

The coho salmon creel survey began on 1 August and ended on 30 September in both the downstream and upstream sections of the river. The survey was conducted similarly to the creel survey of the chinook salmon fishery in the upstream section with the following exceptions. The definition of the fishing day was reduced to 16 hours in August (from 0600 to 2200) and 12 hours in September (from 0800 to 2000) to account for the decreased number of daylight hours. Daily time strata were adjusted for the coho salmon fishery by eliminating period E in August and shifting the starting time of period A to 0600, and in September eliminating period D and shifting the starting time of period A to 0800. The fishing day was the same for both unguided and guided anglers during the creel survey of the coho salmon fishery. The weekday and weekend/holiday stratification was used for both unguided and guided anglers, also. Shore anglers as well as boat anglers were interviewed during the coho salmon creel survey and both completed trip and incompleting trip anglers were interviewed.

#### Angler Counts:

Separate angler count schedules were established for the downstream and upstream sections of the river. Sampling levels were designed to estimate catch and harvest within 25% of the true value 95% of the time. Both creel surveys were designed for one creel survey clerk working 37.5 hours per week.

Angler counts were scheduled for each weekend/holiday day and on 3 randomly selected weekdays each week in both the downstream and upstream sections. Two angler counts were scheduled on each sample day. Sample periods and count times were selected as described for the creel survey of the chinook salmon fishery in the upstream section.

Angler counts were conducted following the procedures described for the counts during the chinook salmon fishery. One exception was that guides were included in the count of guided anglers as they are permitted to fish after 31 July. Shore anglers were considered a separate stratum in the downstream section but combined with unguided boat anglers in the upstream section.

Effort in the midstream section of the river was estimated using the same procedure as during the chinook salmon fishery.

#### Angler Interviews:

During August and September, both shore and boat anglers were interviewed by the creel survey clerks. All angler interviews were conducted on the river, not at boat landings as during the creel survey of the chinook salmon fishery. The same information was recorded for each angler interviewed as during the chinook salmon creel survey, except that both completed and incompleated anglers were included and the docking location was not recorded.

Biological samples for coho salmon (scales, sex, and length) were collected identically to those for the chinook salmon survey.

#### Data Analyses

Angler-effort, harvest and catch rates by species, harvest and catch by species, and associated variances were estimated using the same procedures for the downstream and upstream sections of the chinook and coho salmon fisheries. In the following sections, harvest refers to fish retained by anglers and catch refers to fish retained plus those reported as released by anglers.

There were 15 strata in the chinook salmon fishery in the downstream section of the Kenai River, nine in the early run and six in the late run. The early run strata were: (1) unit 1 (5/16-5/31) - unguided anglers weekdays; (2) unit 1 - unguided anglers weekends/holidays; (3) unit 1 - guided anglers; (4) unit 2 (6/1-6/15) - unguided anglers weekdays; (5) unit 2 - unguided anglers weekends/holidays; (6) unit 2 - guided anglers; (7) unit 3 (6/16-6/30) - unguided anglers weekdays; (8) unit 3 - unguided anglers weekends/holidays; (9) unit 3 - guided anglers. The strata to the late run of the downstream section were: (1) unit 4 (7/1-7/15) - unguided anglers weekdays; (2) unit 4 - unguided anglers weekends/holidays; (3) unit 4 - guided anglers; (4) unit 5 (7/16-7/31) - unguided anglers weekdays; (5) unit 5 - unguided anglers weekends/holidays; (6) unit 5 - guided anglers.

There were six strata in the chinook salmon fishery in the upstream section of the Kenai River, three in the early run and three in the late run. In each early and late run the strata were: (1) unguided anglers weekdays, (2) unguided anglers weekends/holidays, and (3) guided anglers.

There were 12 fishery components in the downstream section and eight in the upstream section during the coho salmon fishery. The early (August 1-August 31) and late run (September 1-September 30) in each section had the same strata: (1) unguided anglers weekdays, (2) unguided anglers

weekends/holidays, (3) guided anglers weekdays, (4) guided anglers weekends/holidays, (5) shore anglers weekdays, and (6) shore anglers weekends/holidays. The shore angler strata were combined with the unguided component in the upstream section during both runs.

Effort:

The number of angler-hours of effort during fishery component  $t$  was estimated as follows (Neuhold and Lu 1957):

$$\hat{E}_t = \sum_{j=1}^s H_{tj} \bar{x}_{tj}, \quad [1]$$

where:

$\bar{x}_{tj}$  = the mean number of anglers per count during period  $j$  of component  $t$ ,

$H_{tj}$  = the total number of hours of possible fishing time during period  $j$  of component  $t$ , and

$s$  = the number of periods (A, B, C, etc.) in component  $t$ .

The variance of effort was estimated as follows (Scheaffer et al. 1979):

$$V(\hat{E}_t) = \sum_{j=1}^s H_{tj}^2 (s_{tj}/n_{tj}), \quad [2]$$

where:

$$s_{tj}^2 = \text{the variance of } \bar{x}_{tj} = \frac{\sum_{o=1}^{n_{tj}} (x_{tjo} - \bar{x}_{tj})^2}{n_{tj} - 1}, \text{ and} \quad [3]$$

$n_{tj}$  = the number of angler counts during period  $j$  of component  $t$ .

A finite population correction factor was not applied as angler counts are considered instantaneous, and so there are an infinite number of counts that can be taken.

Harvest Rates:

Mean effort and mean harvest by species per angler were estimated for each component from angler interview data. Only completed trip interviews were used to make the estimates for the chinook salmon fishery in the downstream section; both completed trip and incompleted trip interviews were used to make the estimates for the chinook salmon fishery in the upstream section and the entire coho salmon fishery.

Mean effort per angler during component t was estimated as:

$$\bar{f}_t = \left( \sum_{i=1}^d \sum_{k=1}^{m_i} f_{ik} \right) / \sum_{i=1}^d m_i, \quad [4]$$

where:

$f_{ik}$  = the effort (in hours) by angler k at the time of the interview on day i,

$m_i$  = the number of anglers interviewed on day i, and

$d$  = the number of days interviews were conducted during component t.

A two-stage sample design with days representing the first-stage sample units and anglers the second-stage sample units was used to estimate the variance of mean effort (Von Geldern and Tomlinson 1973). The number of second-stage units available on a given sample day was unknown. The variance of mean effort was estimated as follows (Sukhatme et al. 1984):

$$V(\bar{f}_t) = [1 - (d/D)] s_B^2/d + \left( \sum_{i=1}^d s_{Wi}^2/m_i \right) / dD, \quad [5]$$

where:

$D$  = the number of days the fishery was open during component t,

$s_{Wi}^2$  = the sample variance of mean effort per angler for interviews conducted on day i, and

$s_B^2$  = the between-day variance of mean effort per angler.

The between-day variance,  $s_B^2$ , was estimated as follows:

$$s_B^2 = \left[ \sum_{i=1}^d (\bar{f}_{ti} - \bar{f}_t)^2 \right] / (d-1), \quad [6]$$

where:

$\bar{f}_{ti}$  = the mean effort per angler during day i of component t.

Mean harvest (or catch) of a species and its variance were estimated identically to effort except the corresponding quantities for harvest (or catch) were substituted for all occurrences of effort (f).

Harvest rate (HPUE) for a species during component t was estimated by:

$$\hat{HPUE}_t = \bar{c}_t / \bar{f}_t, \quad [7]$$

where:

$\bar{c}_t$  = the mean harvest of the species per angler during component t, obtained by substituting catch for effort in equation 4.

The variance of  $\hat{HPUE}_t$  was approximated by the variance for the quotient of the mean of two random variables (Jessen 1978), which is:

$$\hat{V}(\bar{c}_t / \bar{f}_t) \approx (\bar{c}_t / \bar{f}_t)^2 (s_c^2 / c_t^2 + s_f^2 / f_t^2 - 2rs_c s_f / c_t f_t), \quad [8]$$

where:

$s_c^2$  = the two-stage estimate of variance for  $\bar{c}_t$ , obtained by substituting catch for effort in equation 6.

$s_f^2$  = the two-stage estimate of variance for  $\bar{f}_t$  obtained from equation 6, and

r = the correlation coefficient between the  $f_{ik}$  and the  $c_{ik}$  in component t.

Catch per unit effort (CPUE) for a species and its variance were estimated by replacing the mean and variance of number of fish harvested per angler with the mean and variance of the number of fish caught per angler in equations 7 and 8.

Harvest:

The harvest of a species during each component was estimated by:

$$\hat{H}_t = E_t \hat{HPUE}_t. \quad [9]$$

The variance of  $\hat{H}_t$  was estimated using Goodman's (1960) formula for the variance of the product of two independent random variables, which is:

$$\hat{V}(\hat{H}_t) = [E_t^2 \hat{V}(\hat{HPUE}_t)] + [\hat{HPUE}_t^2 \hat{V}(E_t)] - [V(E_t) \hat{V}(\hat{HPUE}_t)]. \quad [10]$$

Totals (for example, the total for unguided anglers during the early run) for effort and harvest were estimated by summing the appropriate component estimates. Estimates of effort and harvest for the components are considered independent estimates, therefore, the variance of the total was estimated by the sum of the appropriate variances.

Catch of a species and its variance were estimated by replacing HPUE with CPUE in equations 9 and 10.

Assumptions:

The major assumptions necessary for these estimates to be unbiased are:

1. Significant fishing effort occurs only between the hours defined for the angler day.
2. Individual effort and harvest (or catch) by anglers are normally distributed random variables.
3. For the coho salmon creel survey, incompleting trip angler interviews provide an unbiased estimate of completed trip HPUE and CPUE (DiConstanzo 1956).
4. Anglers are interviewed in constant proportion to their abundance within each stratum (DiConstanzo 1956) and interviewed anglers are representative of the total angler population.
5. For the coho salmon creel survey, rates of harvest, or catch, and length of fishing trip are independent (DiConstanzo 1956).
6. Catch and harvest rates do not vary among periods within a day.

Midstream Section Effort and Harvest:

Fishing effort in the midstream section of the Kenai River during the chinook salmon creel survey was estimated from the counts of boats made during aerial surveys of the river. The proportion of boat fishing effort occurring in the midstream section was calculated separately for the early run and the late run. For each aerial survey, the proportion of effort in the midstream section ( $p_m$ ) was calculated as the quotient of the number of boats counted in the midstream section and the number of boats counted for all sections. Effort in the midstream section for both guided and unguided anglers ( $E_m$ ) during either the early run or the late run was estimated as follows:

$$\hat{E}_m = \bar{p}_m (\hat{E}_d + \hat{E}_u) / (1 - \bar{p}_m), \quad [11]$$

where  $\bar{p}_m$  = the mean of all proportions ( $p_m$ s) for a run,

$\hat{E}_d$  = the estimated number of angler-hours of effort in the downstream section for a run, and

$\hat{E}_u$  = the estimated number of angler-hours of effort in the upstream section for a run.

Effort was estimated separately for unguided and guided anglers. The variances of the midstream effort estimates were approximated by the delta method (Seber 1982) using the following formula:

$$V(\hat{E}_m) \approx [(\hat{E}_d + \hat{E}_u) / (1 - \bar{p}_m)]^2 V(\bar{p}_m) + [\bar{p}_m / (1 - \bar{p}_m)]^2 V(\hat{E}_d + \hat{E}_u), \quad [12]$$

where the variance of  $\bar{p}$  is the sample variance of the  $p_m$ s divided by the number of flights, the variances of  $\hat{E}_d$  and  $\hat{E}_u$  are estimated as described under Effort, and the covariance between the estimated effort for the downstream and upstream sections and  $\bar{p}$  is assumed to be zero.

Harvest and catch rates during both the chinook and coho salmon fishery in the midstream section were estimated using the total harvest and catch and total effort (angler-hours) for the downstream and upstream sections. This is expressed as:

$$HPUE_m = (\hat{H}_d + \hat{H}_u) / (\hat{E}_d + \hat{E}_u), \quad [13]$$

for the harvest rate and:

$$CPUE_m = (\hat{C}_d + \hat{C}_u) / (\hat{E}_d + \hat{E}_u), \quad [14]$$

for the catch rate, where the subscripts denote the middle (m), downstream (d), or upstream (u) sections of the river. The variances of the rates were approximated by the delta method, also. The following formula was used to estimate the variance of harvest rate (HPUE):

$$V(HPUE_m) \approx [1 / (\hat{E}_d + \hat{E}_u)]^2 V(\hat{H}_d + \hat{H}_u) + [-(\hat{H}_d + \hat{H}_u) / (\hat{E}_d + \hat{E}_u)^2]^2 V(\hat{E}_d + \hat{E}_u), \quad [15]$$

where the variances of  $(\hat{E}_d + \hat{E}_u)$  and  $(\hat{H}_d + \hat{H}_u)$  are calculated as described previously in equations 12 and 15. The covariance between the combined downstream and upstream effort and harvest is omitted from the above equation because it is unknown, although it is assumed positive (as effort increases harvest should increase). The product of the covariance and the derivatives of the numerator and denominator of  $HPUE_m$  (or  $CPUE_m$ ) would be subtracted from equation 14 because of the negative derivative for the denominator. Therefore, the formula above is probably a conservative estimate of the variance of  $HPUE_m$ . The variance of  $CPUE_m$  was estimated using the same formula but the combined downstream and upstream catches and their variances were substituted for the harvest counterparts.

The harvest and catch of coho salmon in the midstream section were estimated for unguided and guided anglers following the procedures described for the

downstream and upstream sections. The variances of these estimates were also estimated as described previously in equations 12 and 15.

#### Biological Data:

The proportional age composition of the chinook and coho salmon harvest was estimated for each run. Letting  $p_{ht}$  equal the estimated proportion of age group  $h$  in component  $t$ , the variance of  $p_{ht}$  was estimated as (Scheaffer et al. 1979):

$$V(\hat{p}_{ht}) = \hat{p}_{ht}(1-\hat{p}_{ht})/(\hat{n}_{Tt}-1), \quad [16]$$

where  $\hat{n}_{Tt}$  is the number of legible scales read from chinook or coho salmon sampled during component  $t$ .

Mean length at age by sex and its variance were estimated using standard normal procedures (Sokal and Rohlf 1981, Boxes 4.2 and 7.1, pages 56 and 139).

## RESULTS

The following dates, based on the criteria described previously, were used to define the early and late runs in the chinook salmon fishery. The early run was from 16 May through 30 June and the late run from 1 July through 31 July in the downstream section. In the upstream section, the early run was from 11 June through 9 July and the late run from 10 July through 31 July. During the coho salmon fishery, the early run was designated from 1 August through 31 August and the late run from 1 September through 30 September in both the downstream and upstream sections of the river.

### Chinook Salmon Creel Survey

Because of mechanical and other logistical problems during the creel survey in the downstream section of the Kenai River, angler counts were conducted on only 63 of the 67 days possible and interviews were conducted on 64 of the 67 days. In the upstream section, 36 of the 43 days possible were surveyed.

#### Effort:

Between one and five angler counts were conducted on each sample day in the downstream section (Appendices A1 and A2). In the upstream section, two angler counts were conducted on each day surveyed except one (Appendices A3 and A4).

Downstream Section. Angler counts in the downstream section ranged from 3 to 698 for unguided anglers and from 0 to 550 for guided anglers (Appendices A1 and A2). The largest count of both unguided and guided anglers occurred on 18 July. Except for unguided angler counts during periods C, D, and E during the late run, the mean counts of unguided and guided anglers increased as the season progressed (Table 1).

Table 1. Mean counts of boat anglers by period for each of the components for the creel survey of the fishery for chinook salmon in the downstream section of the Kenai River, 1989.

Component	Period <sup>a</sup>				
	A	B	C	D	E
<u>EARLY RUN</u>					
Period 1 (16 May - 31 May)					
Unguided anglers, weekdays:					
Number of counts	4	3	4	4	3
Mean count	23.8	41.0	31.0	40.8	28.0
Standard error	5.4	15.1	7.4	2.9	10.7
Unguided anglers, weekends:					
Number of counts	4	4	4	4	3
Mean count	30.5	150.8	165.3	145.0	86.0
Standard error	22.6	41.0	47.7	37.6	31.9
Guided anglers, all days:					
Number of counts	8	7	8	8	6
Mean count	40.9	128.1	66.8	64.6	3.5
Standard error	19.6	16.9	11.0	12.3	0.9
Period 2 (1 June - 16 June)					
Unguided anglers, weekdays:					
Number of counts	4	4	4	4	5
Mean count	109.8	179.3	119.3	143.8	125.6
Standard error	43.6	25.2	32.5	23.8	34.2
Unguided anglers, weekends:					
Number of counts	4	4	4	4	4
Mean count	150.8	321.3	244.3	214.5	170.5
Standard error	49.5	32.2	44.9	49.3	47.2
Guided anglers, all days:					
Number of counts	13	11			
Mean count	254.7	200.4			
Standard error	26.9	9.9			

- Continued -

Table 1. (Page 2 of 3).

Component	Period <sup>a</sup>				
	A	B	C	D	E
Period 3 (17 June - 30 June)					
Unguided anglers, weekdays:					
Number of counts	2	3	2	3	2
Mean count	102.5	223.3	115.0	162.7	112.0
Standard error	39.5	38.7	10.0	14.3	33.0
Unguided anglers, weekends:					
Number of counts	4	4	3	4	4
Mean count	165.0	285.8	275.0	285.3	173.5
Standard error	40.6	28.8	67.7	45.0	52.4
Guided anglers, all days:					
Number of counts	9	10			
Mean count	312.8	207.6			
Standard error	17.4	11.1			
<u>LATE RUN</u>					
Period 4 (1 July - 16 July)					
Unguided anglers, weekdays:					
Number of counts	2	5	3	4	3
Mean count	295.0	408.4	309.7	268.5	157.3
Standard error	29.0	71.8	56.9	45.8	39.9
Unguided anglers, weekends:					
Number of counts	7	7	7	7	7
Mean count	332.4	517.6	463.3	430.3	274.6
Standard error	62.5	53.6	50.4	40.5	50.0
Guided anglers, all days:					
Number of counts	11	11			
Mean count	370.5	268.7			
Standard error	28.3	23.3			

- Continued -

Table 1. (Page 3 of 3).

Component	Period <sup>a</sup>				
	A	B	C	D	E
Period 5 (17 July - 31 July)					
Unguided anglers, weekdays:					
Number of counts	4	4	4	4	4
Mean count	436.0	490.3	359.3	278.5	260.8
Standard error	87.5	61.4	59.2	24.7	68.2
Unguided anglers, weekends:					
Number of counts	3	4	4	4	3
Mean count	364.0	549.8	413.5	365.0	257.3
Standard error	13.7	35.6	23.8	60.2	73.3
Guided anglers, all days:					
Number of counts	9	10			
Mean count	430.8	307.8			
Standard error	22.0	26.1			

<sup>a</sup> Unguided anglers all months:  
 Period A = 0400 - 0759  
 Period B = 0800 - 1159  
 Period C = 1200 - 1559  
 Period D = 1600 - 1959  
 Period E = 2000 - 2359

Guided angler:  
 May: same as unguided  
 June and July: Period A = 1600 - 1159  
 Period A = 1200 - 1759

The estimated effort during the early run was 198,629 angler-hours (Table 2). During the early run, 53% of the total effort was by unguided anglers. Of this effort, 54% occurred during weekdays and 46% during weekends/holidays. The estimated effort during the late run was 272,889 angler-hours (Table 2). The majority of this effort (68%) was by unguided anglers. Of the unguided effort, 53% occurred during weekdays and 47% during weekends/holidays.

Upstream Section. Angler counts in the upstream section ranged from 0 to 138 for unguided anglers and from 0 to 20 for guided anglers (Appendices A3 and A4). The largest count of unguided anglers occurred on 7 July and the largest count of guided anglers on 22 July. For each period of both runs, the mean count of unguided anglers for the weekend/holiday component was larger than the mean count for the weekday component (Table 3).

The estimated effort during the early run was 19,716 angler-hours (Table 4). During the early run, 94% of the total effort was by unguided anglers. Of the unguided effort, 33% occurred during weekdays and 67% during weekends/holidays. During the late run, there were not enough counts of unguided anglers conducted in period E of the weekday component and in period D of the weekend/holiday component to estimate effort using the stratified estimate. For these components, effort was estimated using the mean of all counts in the component. The estimation procedures were the same as for the stratified random sample except that there was no summation over periods and the mean and sample variance in equations 1 and 2 refer to the entire component. The estimated effort during the late run was 21,250 angler-hours (Table 4). The majority of this effort (95%) was by unguided anglers.

Midstream Section. The counts of sportfishing boats in each section of the Kenai River between Skilak Lake and Cook Inlet, conducted during aerial surveys, are summarized in Table 5. Twelve counts were conducted during the early run and 11 counts during the late run. The mean proportion of the total boat effort in the midstream section was 0.069 for the early run and 0.106 for the late run. Because boats with unguided anglers cannot be distinguished from boats with guided anglers from the air, the estimated proportion of effort in the midstream section during each run was used to estimate both unguided and guided angler effort. Estimated effort for the midstream section during the early run was 9,127 angler-hours for unguided anglers (standard error [SE] = 3,939) and 7,055 angler-hours for guided anglers (SE = 3,041). During the late run, estimated effort for the midstream section was 24,518 angler-hours for unguided anglers (SE = 8,853) and 10,394 angler-hours for guided anglers (SE = 3,756).

#### Harvest Rates and Catch Rates:

A total of 4,529 interviews with completed trip anglers were collected during the creel survey in the downstream section of the Kenai River, 2,342 interviews during the early run and 2,187 interviews during the late run. In the upstream section, 2,818 interviews, both incompletd and completed trip anglers were collected, 1,449 interviews during the early run and 1,369 interviews during the late run.

Table 2. Estimated number of angler-hours of fishing effort by boat anglers during each of the components of the fishery for chinook salmon in the downstream section of the Kenai River, 1989.

Component	Estimated Effort	Standard Error	95% Confidence Interval	Relative Precision
<u>EARLY RUN</u>				
Period 1 (16 May - 31 May)				
Unguided weekdays	6,580	836	4,941 - 8,219	24.9%
Unguided weekends	11,550	1,660	8,296 - 14,804	28.2%
Guided	18,235	1,838	14,633 - 21,837	19.8%
Period 2 (1 June - 16 June)				
Unguided weekdays	27,104	2,920	21,380 - 32,828	21.1%
Unguided weekends	17,620	1,613	14,459 - 20,781	17.9%
Guided	38,225	2,404	33,513 - 42,937	12.3%
Period 3 (17 June - 30 June)				
Unguided weekdays	22,896	2,154	18,675 - 27,117	18.4%
Unguided weekends	18,952	1,740	15,542 - 22,362	18.0%
Guided	37,467	1,490	34,546 - 40,388	7.8%
Sub-totals:				
Unguided anglers	104,702	4,717	95,457 - 113,947	8.8%
Guided anglers	93,927	3,373	87,316 - 100,538	7.0%
Early Run Total	198,629	5,799	187,263 - 209,995	5.7%

- Continued -

Table 2. (Page 2 of 2).

Component	Estimated Effort	Standard Error	95% Confidence Interval	Relative Precision
<u>LATE RUN</u>				
Period 4 (1 June - 16 July)				
Unguided weekdays	40,289	3,182	34,052 - 46,526	15.5%
Unguided weekends	56,508	3,248	50,141 - 62,875	11.3%
Guided	42,192	2,416	37,457 - 46,927	11.2%
Period 5 (17 July - 31 July)				
Unguided weekdays	58,392	4,547	49,480 - 67,304	15.3%
Unguided weekends	31,193	1,679	27,902 - 34,484	10.6%
Guided	44,315	2,046	40,305 - 48,325	9.0%
Sub-totals:				
Unguided anglers	186,382	6,646	173,355 - 199,409	7.0%
Guided anglers	86,507	3,166	80,302 - 92,712	7.2%
Late Run Total	272,889	7,362	258,460 - 287,318	5.3%
<u>BOTH RUNS COMBINED</u>				
Unguided anglers	291,084	8,150	275,110 - 307,058	5.5%
Guided anglers	180,434	4,626	171,367 - 189,501	5.0%
GRAND TOTAL	471,518	9,372	453,149 - 489,887	3.9%

Table 3. Mean counts of boat anglers by period for each of the components for the creel survey of the fishery for chinook salmon in the upstream section of the Kenai River, 1989.

Component	Period				
	A	B	C	D	E
<u>EARLY RUN</u>					
Unguided anglers, weekdays:					
Number of counts	4	4	5	5	4
Mean count	3.5	25.8	26.6	21.0	26.0
Standard error	2.2	4.5	10.0	4.7	6.2
Unguided anglers, weekends:					
Number of counts	3	3	5	4	2
Mean count	12.7	92.7	101.2	32.5	68.0
Standard error	5.2	28.9	11.8	17.2	18.0
Guided anglers, all days:					
Number of counts	7	11			
Mean count	5.4	3.7			
Standard error	1.6	1.2			
<u>LATE RUN</u>					
Unguided anglers, weekdays:					
Number of counts	3	4	4	4	1
Mean count	13.7	59.8	76.5	53.5	7.0
Standard error	5.8	12.6	7.9	10.0	
Unguided anglers, weekends:					
Number of counts	2	3	3	1	3
Mean count	24.0	84.3	87.7	74.0	56.7
Standard error	20.0	18.8	21.2		24.3
Guided anglers, all days:					
Number of counts	8	6			
Mean count	7.5	4.3			
Standard error	2.5	1.4			

Table 4. Estimated number of angler-hours of fishing effort by boat anglers during each of the components of the fishery for chinook salmon in the upstream section of the Kenai River, 1989.

Component	Estimated Effort	Standard Error	95% Confidence Interval	Relative Precision
<u>EARLY RUN</u>				
Unguided weekdays	6,171	820	4,565 - 7,777	26.0%
Unguided weekends	12,282	1,611	9,125 - 15,439	25.7%
Guided	1,263	282	711 - 1,815	43.7%
Sub-totals:				
Unguided anglers	18,453	1,807	14,911 - 21,995	19.2%
Guided anglers	1,263	282	711 - 1,815	43.7%
Early Run Total	19,716	1,829	16,131 - 23,301	18.2%
<u>LATE RUN</u>				
Unguided weekdays	12,105	1,637	8,897 - 15,313	26.5%
Unguided weekends	8,080	817	6,478 - 9,682	19.8%
Guided	1,065	261	554 - 1,576	48.0%
Sub-totals:				
Unguided anglers	20,185	1,829	16,600 - 23,770	17.8%
Guided anglers	1,065	261	554 - 1,576	48.0%
Late Run Total	21,250	1,848	17,629 - 24,871	17.0%
<u>BOTH RUNS COMBINED</u>				
Unguided anglers	38,638	2,571	33,329 - 43,677	13.0%
Guided anglers	2,328	384	1,575 - 3,081	32.3%
GRAND TOTAL	40,966	2,600	35,870 - 46,062	12.4%

Table 5. Counts of sport fishing boats by river section conducted during aerial surveys of the fishery for chinook salmon in the Kenai River, 1989.

Date	<u>Downstream</u>		<u>Midstream</u>		<u>Upstream</u>		Total Count
	Count	Pro. <sup>a</sup>	Count	Pro. <sup>a</sup>	Count	Pro. <sup>a</sup>	
<u>EARLY RUN</u>							
5/28	121	0.890	7	0.051	8	0.059	136
6/02	58	0.967	2	0.033	0	0.000	60
6/03	150	0.962	5	0.032	1	0.006	156
6/07	55	0.887	4	0.065	3	0.048	62
6/08	160	0.879	18	0.099	4	0.022	182
6/10	88	0.854	5	0.049	10	0.097	103
6/15	113	0.856	9	0.068	10	0.076	132
6/18	138	0.758	19	0.104	25	0.137	182
6/20	221	0.902	12	0.049	12	0.049	245
6/21	96	0.800	12	0.100	12	0.100	120
6/25	88	0.772	8	0.070	18	0.158	114
6/27	168	0.753	24	0.108	31	0.139	223
Mean		0.857		0.069		0.074	
Standard Error		0.073		0.028		0.053	
<u>LATE RUN</u>							
7/02	143	0.715	17	0.085	40	0.200	200
7/06	183	0.867	17	0.081	11	0.052	211
7/07	106	0.822	7	0.054	16	0.124	129
7/08	142	0.736	18	0.093	33	0.171	193
7/11	232	0.808	31	0.108	24	0.084	287
7/13	135	0.865	11	0.071	10	0.064	156
7/15	86	0.688	15	0.120	24	0.192	125
7/21	142	0.679	30	0.144	37	0.177	209
7/22	242	0.740	39	0.119	46	0.141	327
7/25	220	0.797	33	0.120	23	0.083	276
7/26	234	0.793	51	0.173	10	0.034	295
Mean		0.774		0.106		0.120	
Standard Error		0.066		0.034		0.060	

<sup>a</sup> Proportion of total count.

Downstream Section. Daily harvest rates of chinook salmon by unguided anglers ranged from 0.000 to 0.179 fish per hour during the early run and from 0.000 to 0.075 fish per hour during the late run (Appendices B1 and B3). Peak daily catch rates of chinook salmon by unguided anglers occurred on 7 June during the early run and on 28 July during the late run (Figure 5). Daily harvest rates of chinook salmon by guided anglers ranged from 0.000 to 0.204 fish per hour during the early run and from 0.000 to 0.118 fish per hour during the late run (Appendices B2 and B4). Peak daily catch rates of chinook salmon by guided anglers occurred on 2 June during the early run and 7 July during the late run (Figure 5). Estimates of overall harvest and catch rates of chinook salmon for each of the components were higher for guided anglers than for unguided anglers in all components (Table 6).

The only difference in catch and harvest rates of the by-catch for guided and unguided anglers occurred during the late run for sockeye salmon (Table 7). The guided catch rate was approximately one tenth that of the unguided angler.

Upstream Section. Daily harvest rates of chinook salmon by unguided anglers ranged from 0.000 to 0.009 fish per hour during the early run and from 0.000 to 0.023 fish per hour during the late run (Appendices B5 and B6). Peak daily catch rates of chinook salmon by unguided anglers occurred on 8 July during the early run and on 15 July during the late run. Daily harvest rates of chinook salmon by guided anglers ranged from 0.000 to 0.333 fish per hour during the early run (Appendix B7) and from 0.000 to 0.102 during the late run. Peak daily catch rates of chinook salmon by guided anglers occurred on 24 June during the early run and on 18 July during the late run. For the early run, estimates of overall harvest and catch rates of chinook salmon for each of the components were higher for guided anglers than for unguided anglers in all components (Table 8).

In the upstream section, the catch rates for other species were greater for unguided anglers than guided anglers during the early run; the reverse was true during the late run except for pink salmon (Table 9).

#### Harvest and Catch:

Downstream Section. An estimated 14,719 chinook salmon were harvested by boat anglers in the downstream section: 6,711 fish (46%) during the early run and 8,008 fish (54%) during the late run (Table 10). Unguided anglers harvested 5,114 chinook salmon (35% of the total) and guided anglers harvested 9,605 fish (65% of the total). The total catch of chinook salmon by boat anglers in the downstream section was 19,559 fish: 9,034 fish (46%) during the early run and 10,525 fish (54%) during the late run (Table 10). Unguided anglers released 29% of their chinook salmon catch while guided anglers released 22% of their catch.

Upstream Section. An estimated 264 chinook salmon were harvested by boat anglers in the upstream section: 95 fish (36%) during the early run and 169 fish (64%) during the late run (Table 11). Unguided anglers harvested 146 chinook salmon (55% of the total) and guided anglers harvested 118 fish (45% of the total). The total catch of chinook salmon by boat anglers in the

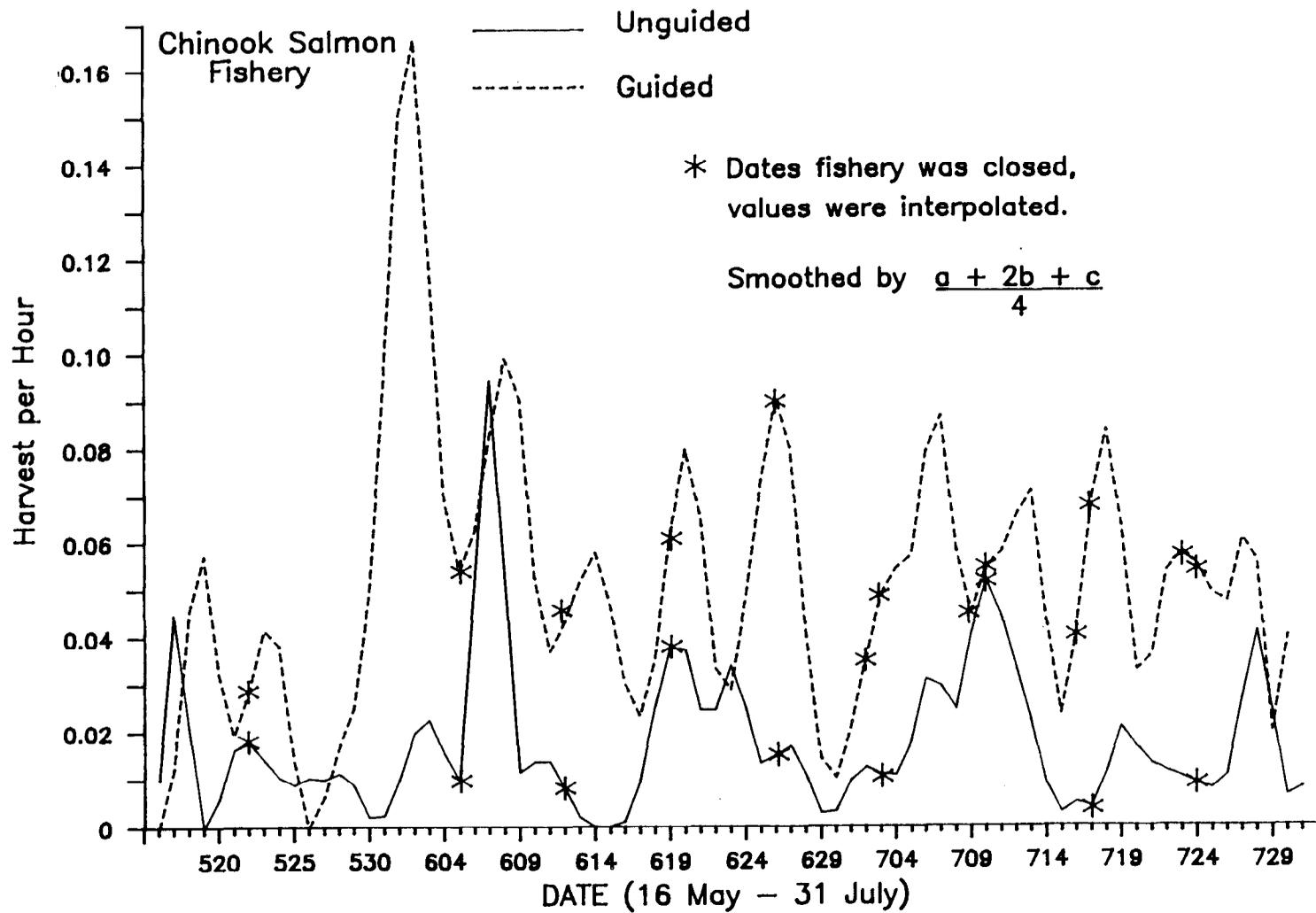


Figure 5. Daily harvest per hour of chinook salmon by guided and unguided anglers in the recreational fishery for chinook salmon in the downstream section of the Kenai River, 1989.

Table 6. Estimated harvest per unit effort (HPUE) and catch per unit effort (CPUE) of chinook salmon by boat anglers during each of the components of the fishery for chinook salmon in the downstream section of the Kenai River, 1989.

Component	Temporal Period	<u>Days</u>		Number of Interviews <sup>c</sup>	Harvest HPUE	Standard Error	Catch CPUE	Standard Error
		n <sup>a</sup>	N <sup>b</sup>					
<u>EARLY RUN</u>								
Unguided weekdays	5/16-5/31	9	10	124	0.0153	0.00430	0.0153	0.00430
Unguided weekends	5/16-5/31	5	5	142	0.0099	0.00617	0.0158	0.00704
Guided all days	5/16-5/31	12	15	117	0.0260	0.00810	0.0278	0.01150
Unguided weekdays	6/01-6/16	8	10	252	0.0179	0.00739	0.0349	0.00913
Unguided weekends	6/01-6/16	4	4	319	0.0180	0.00358	0.0215	0.00396
Guided all days	6/01-6/16	13	14	373	0.0715	0.00769	0.0890	0.00878
Unguided weekdays	6/17-6/30	8	8	333	0.0248	0.00382	0.0340	0.00444
Unguided weekends	6/17-6/30	4	4	226	0.0131	0.00466	0.0174	0.00558
Guided all days	6/17-6/30	12	12	456	0.0446	0.00419	0.0643	0.00516

-Continued-

Table 6. (Page 2 of 2).

Component	Temporal Period	Days		Number of Interviews <sup>c</sup>	Harvest HPUE	Standard Error	Catch CPUE	Standard Error
		n <sup>a</sup>	N <sup>b</sup>					
<u>LATE RUN</u>								
Unguided weekdays	7/01-7/16	7	7	338	0.0261	0.00544	0.0406	0.00670
Unguided weekends	7/01-7/16	7	7	388	0.0175	0.00264	0.0224	0.00362
Guided all days	7/01-7/16	11	11	342	0.0589	0.00594	0.0800	0.00659
Unguided weekdays	7/17-7/31	8	8	352	0.0168	0.00815	0.0208	0.01071
Unguided weekends	7/17-7/31	4	4	264	0.0083	0.00289	0.0124	0.00333
Guided all days	7/17-7/31	10	10	503	0.0506	0.00427	0.0597	0.00478

<sup>a</sup> Number of days on which interviews were collected.

<sup>b</sup> Number of days possible for interviewing.

<sup>c</sup> Completed trip interviews only.

Table 7. Estimated harvest per unit effort (HPUE) and catch per unit effort (CPUE) of sockeye salmon, coho salmon, pink salmon rainbow trout, and Dolly Varden by boat anglers during each of the components of the fishery for chinook salmon in the downstream section of the Kenai River, 1989.

Component	<u>SOCKEYE SALMON</u>		<u>COHO SALMON</u>		<u>PINK SALMON</u>		<u>RAINBOW TROUT</u>		<u>DOLLY VARDEN</u>	
	HPUE	CPUE	HPUE	CPUE	HPUE	CPUE	HPUE	CPUE	HPUE	CPUE
<u>EARLY RUN</u>										
Unguided weekdays	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
(Standard Error)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0004)	(0.0000)	(0.0000)
Unguided weekends	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0002	0.0002
(Standard Error)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0006)	(0.0006)
Guided all days	0.0005	0.0005	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0003	0.0003
(Standard Error)	(0.0021)	(0.0021)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0003)	(0.0003)
<u>LATE RUN</u>										
Unguided weekdays	0.0992	0.0992	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0044	0.0051
(Standard Error)	(0.0222)	(0.0222)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0100)	(0.0103)
Unguided weekends	0.0804	0.0804	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0029	0.0029
(Standard Error)	(0.0254)	(0.0254)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0019)	(0.0019)
Guided all days	0.0084	0.0084	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0056	0.0078
(Standard Error)	(0.0075)	(0.0075)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.00123)	(0.0029)

Table 8. Estimated harvest per unit effort (HPUE) and catch per unit effort (CPUE) of chinook salmon by boat anglers during each of the components of the fishery for chinook salmon in the upstream section of the Kenai River, 1989.

Component	Days		Number of Interviews <sup>c</sup>	Harvest HPUE	Standard Error	Catch CPUE	Standard Error
	n <sup>a</sup>	N <sup>b</sup>					
<u>EARLY RUN</u>							
Unguided weekdays	12	15	546	0.0016	0.00073	0.0064	0.00161
Unguided weekends	9	10	830	0.0017	0.00098	0.0022	0.00114
Guided all days	13	22	73	0.0507	0.01561	0.0897	0.03242
<u>LATE RUN</u>							
Unguided weekdays	8	12	665	0.0044	0.00204	0.0119	0.00328
Unguided weekends	6	6	636	0.0077	0.00211	0.0109	0.00252
Guided all days	10	15	68	0.0510	0.01482	0.0849	0.03038

<sup>a</sup> Number of days on which interviews were collected.

<sup>b</sup> Number of days possible for interviewing.

<sup>c</sup> Completed trip and incompleted trip interviews.

Table 9. Estimated harvest per unit effort (HPUE) and catch per unit effort (CPUE) of sockeye salmon, coho salmon, pink salmon, rainbow trout, and Dolly Varden by boat anglers during each of the components of the fishery for chinook salmon in the upstream section of the Kenai River, 1989.

Component	<u>SOCKEYE SALMON</u>		<u>COHO SALMON</u>		<u>PINK SALMON</u>		<u>RAINBOW TROUT</u>		<u>DOLLY VARDEN</u>	
	HPUE	CPUE	HPUE	CPUE	HPUE	CPUE	HPUE	CPUE	HPUE	CPUE
<u>EARLY RUN</u>										
Unguided weekdays	0.0016	0.0016	0.0000	0.0000	0.0000	0.0000	0.0136	0.0739	0.0699	0.1469
(Standard Error)	(0.0010)	(0.0010)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0036)	(0.0190)	(0.0106)	(0.0197)
Unguided weekends	0.0006	0.0011	0.0000	0.0000	0.0000	0.0000	0.0014	0.0558	0.0825	0.1651
(Standard Error)	(0.0004)	(0.0004)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0030)	(0.0184)	(0.0162)	(0.0277)
Guided all days	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0156	0.0585	0.0468	0.1092
(Standard Error)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0146)	(0.0215)	(0.0265)	(0.0550)
<u>LATE RUN</u>										
Unguided weekdays	0.1870	0.3021	0.0000	0.0000	0.0006	0.0031	0.0031	0.0063	0.0394	0.0813
(Standard Error)	(0.0241)	(0.0369)	(0.0000)	(0.0000)	(0.0006)	(0.0051)	(0.0018)	(0.0030)	(0.0062)	(0.0103)
Unguided weekends	0.1936	0.4134	0.0000	0.0000	0.0000	0.0000	0.0038	0.0128	0.0294	0.0556
(Standard Error)	(0.0144)	(0.0352)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0016)	(0.0032)	(0.0067)	(0.0096)
Guided	0.0255	0.0382	0.0000	0.0000	0.0000	0.0000	0.0042	0.1274	0.0849	0.2208
(Standard Error)	(0.0208)	(0.0288)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0072)	(0.0706)	(0.0405)	(0.0750)

Table 10. Estimated number of chinook salmon harvested and number caught by boat anglers during each of the components in the fishery for chinook salmon in the downstream section of the Kenai River, 1989.

Component	Harvest <sup>a</sup>	Standard Error	Rel. Pre. <sup>b</sup>	Catch <sup>c</sup>	Standard Error	Rel. Pre. <sup>b</sup>
<u>EARLY RUN</u>						
Unguided weekdays	1,154	232	39.4%	1,825	296	31.8%
Unguided weekends	679	135	39.0%	891	159	34.9%
Guided all days	4,878	410	16.5%	6,318	501	15.5%
Sub-totals:						
Unguided	1,833	268	28.7%	2,716	336	24.2%
Guided	4,878	410	16.5%	6,318	501	15.5%
Early Run Total	6,711	490	14.3%	9,034	603	13.1%
<u>LATE RUN</u>						
Unguided weekdays	2,033	331	31.9%	2,851	702	48.3%
Unguided weekends	1,248	184	28.9%	1,653	241	28.6%
Guided all days	4,727	360	14.9%	6,021	417	13.6%
Sub-totals:						
Unguided	3,281	379	22.6%	4,504	743	32.3%
Guided	4,727	360	14.9%	6,021	417	13.6%
Late Run Total	8,008	522	12.8%	10,525	852	15.9%
<u>BOTH RUNS COMBINED</u>						
Unguided	5,114	464	17.8%	7,220	824	22.4%
Guided	9,605	546	11.1%	12,339	652	10.4%
GRAND TOTAL	14,719	716	9.5%	19,559	1,044	10.5%

<sup>a</sup> Harvest includes only fish kept.

<sup>b</sup> Relative precision for 95% confidence interval.

<sup>c</sup> Catch includes fish kept and fish reported as released.

Table 11. Estimated number of chinook salmon harvested and number caught by boat anglers during each of the components in the fishery for chinook salmon in the upstream section of the Kenai River, 1989.

Component	Harvest <sup>a</sup>	Standard Error	Rel. Pre. <sup>b</sup>	Catch <sup>c</sup>	Standard Error	Rel. Pre. <sup>b</sup>
<u>EARLY RUN</u>						
Unguided weekdays	10	5	90.8%	39	11	56.1%
Unguided weekends	21	12	114.0%	27	14	104.1%
Guided all days	64	24	73.3%	113	47	82.0%
Sub-totals:						
Unguided	31	13	82.6%	66	18	54.0%
Guided	64	24	73.3%	113	47	82.0%
Early Run Total	95	27	56.3%	179	512	55.4%
<u>LATE RUN</u>						
Unguided weekdays	53	26	94.4%	144	44	59.7%
Unguided weekends	62	18	57.3%	88	22	49.2%
Guided all days	54	20	73.6%	90	38	83.6%
Sub-totals:						
Unguided	115	31	53.4%	232	49	41.5%
Guided	54	20	73.6%	90	38	83.6%
Late Run Total	169	37	43.3%	322	62	38.0%
<u>BOTH RUNS COMBINED</u>						
Unguided	146	34	45.6%	298	52	34.2%
Guided	118	31	51.5%	203	60	57.9%
GRAND TOTAL	264	46	34.2%	501	80	31.3%

<sup>a</sup> Harvest includes only fish kept.

<sup>b</sup> Relative precision for 95% confidence interval.

<sup>c</sup> Catch includes fish kept and fish reported as released.

upstream fishery was 501 fish: 179 fish (36%) during the early run and 322 fish (64%) during the late run (Table 11). Unguided anglers released 51% of their chinook salmon catch while guided anglers released 42% of their catch.

Midstream Section. During the early run, an estimated 450 chinook salmon (SE = 164) were harvested in the midstream section. The estimated catch of chinook salmon during the early run was 688 (SE = 241). The estimated harvest of chinook salmon for the midstream section during the late run was 950 (SE = 254). The estimated catch of chinook salmon during the late run was 1,363 (SE = 367).

Other Species. Sockeye salmon were the most common species caught in both the downstream (17,570 sockeye salmon were harvested; none were reported released) and upstream sections (3,855 fish were harvested and 7,038 fish were caught) (Tables 12 and 13). A large number of Dolly Varden were harvested in both the downstream (1,215) and upstream (2,537) fisheries.

#### Summary:

The estimated total angler-effort during the chinook salmon fishery was 563,579 angler-hours (Table 14). Estimated total harvest and catch of chinook salmon were 16,383 fish and 22,111 fish, respectively (Table 14). Unguided anglers exerted 64.5% of the effort and harvested 35.1% of the chinook salmon while guided anglers exerted 35.5% of the effort and harvested 64.9% of the fish. The majority of the effort (83.7%) and chinook salmon harvest (89.9%) were estimated to occur in the downstream section of the fishery (Figure 6). Just 7.3% occurred in the upstream section and 9.0% in the midstream section. Only 1.6% of the chinook salmon harvest was from the upstream section and 8.5% from the midstream section.

#### Biological Data:

The most abundant age groups in the early run harvest were ages 1.3 and 1.4 chinook salmon which composed 26.5% and 63.0% of the sample, respectively (Table 15). Ages 1.4 and 1.5 chinook salmon were the most abundant age groups in the late run harvest, contributing 71.9% and 15.6% to the sample, respectively (Table 15). The mean lengths at age for each sex were generally greater for late run fish than for early run fish (Table 16). For both the early and late runs, the mean lengths of 3-, 4- and 5-ocean age male chinook salmon sampled from the harvest were generally larger than the mean lengths of females from the same age group.

#### Discussion:

The major assumptions necessary for the effort and harvest estimates were explained in the Methods section. It is important to determine how well the data conform to these assumptions to evaluate whether the current experimental design and methods of analysis are appropriate. It is beyond the scope of this report to examine every assumption, but several were examined.

The assumption that interviews with unguided and guided anglers were conducted in proportion to the abundance of anglers at the time of the interview

Table 12. Estimated number of sockeye salmon, coho salmon, pink salmon, rainbow trout, and Dolly Varden harvested and caught by boat anglers during the fishery for chinook salmon in the downstream section of the Kenai River, 1989.

Species	<u>Unguided Anglers</u>				<u>Guided Anglers</u>				<u>Total</u>			
	Harv. <sup>a</sup>	SE	Catch <sup>b</sup>	SE	Harv. <sup>a</sup>	SE	Catch <sup>b</sup>	SE	Harv. <sup>a</sup>	SE	Catch <sup>b</sup>	SE
<u>EARLY RUN</u>												
Sockeye salmon	0	0	0	0	42	80	42	80	42	80	42	80
Rainbow trout	0	0	0	0	0	0	0	0	0	0	0	0
Dolly Varden	12	11	12	11	23	11	23	11	35	15	35	15
<u>LATE RUN</u>												
Sockeye salmon	16,843	1,685	16,843	1,685	727	327	727	327	17,570	1,716	17,570	1,716
Coho salmon	0	0	0	0	0	0	0	0	0	0	0	0
Pink Salmon	0	0	0	0	0	0	0	0	0	0	0	0
Rainbow trout	0	0	0	0	0	0	0	0	0	0	0	0
Dolly Varden	695	586	764	594	485	100	679	125	1,180	595	1,443	607

<sup>a</sup> Harvest includes only fish kept.

<sup>b</sup> Catch includes fish kept and fish reported as released.

Table 13. Estimated number of sockeye salmon, coho salmon, pink salmon, rainbow trout, and Dolly Varden harvested and caught by boat anglers during the fishery for chinook salmon in the upstream section of the Kenai River, 1989.

Species	Unguided Anglers				Guided Anglers				Total			
	Harv. <sup>a</sup>	SE	Catch <sup>b</sup>	SE	Harv. <sup>a</sup>	SE	Catch <sup>b</sup>	SE	Harv. <sup>a</sup>	SE	Catch <sup>b</sup>	SE
<u>EARLY RUN</u>												
Sockeye salmon	21	10	28	12	0	0	0	0	21	10	28	12
Rainbow trout	296	56	1,341	315	20	19	73	31	316	59	1,414	317
Dolly Varden	1,673	277	3,404	504	59	35	137	74	1,732	279	3,541	509
<u>LATE RUN</u>												
Sockeye salmon	3,828	464	6,997	797	27	23	41	31	3,855	465	7,038	797
Coho salmon	0	0	0	0	0	0	0	0	0	0	0	0
Pink Salmon	0	0	0	0	7	7	69	44	7	7	69	44
Rainbow Trout	69	26	179	46	4	8	136	80	73	27	315	93
Dolly Varden	715	114	1,433	202	90	47	235	97	805	124	1,668	224

<sup>a</sup> Harvest includes only fish kept.

<sup>b</sup> Catch includes fish kept and fish reported as released.

Table 14. Summary of estimated angler effort, chinook salmon harvest, and chinook salmon catch by all boat anglers for each river section of the fishery for chinook salmon in the Kenai River, 1989.

Run	Downstream Section	Upstream Section	Midstream Section	Total	95% Confidence Interval
<u>Early Run</u>					
Effort	198,629	19,716	16,182	234,527	219,127 - 249,927
SE	5,799	1,829	4,976	7,857	
Harvest	6,711	95	450	7,256	6,242 - 8,270
SE	490	27	164	517	
Catch	9,034	179	688	9,901	8,624 - 11,178
SE	603	51	241	651	
<u>Late Run</u>					
Effort	272,889	21,250	34,912	329,051	305,038 - 353,064
SE	7,362	1,848	9,617	12,252	
Harvest	8,008	169	950	9,127	7,987 - 10,267
SE	522	37	254	582	
Catch	10,525	322	1,363	12,210	10,388 - 14,032
SE	852	62	367	930	
<u>Total Both Runs</u>					
Effort	471,518	40,966	51,095	563,579	535,052 - 592,106
SE	9,372	2,600	10,828	14,555	
Harvest	14,719	264	1,400	16,383	14,857 - 17,909
SE	716	46	302	779	
Catch	19,559	501	2,051	22,111	19,886 - 24,336
SE	1,044	80	424	1,135	

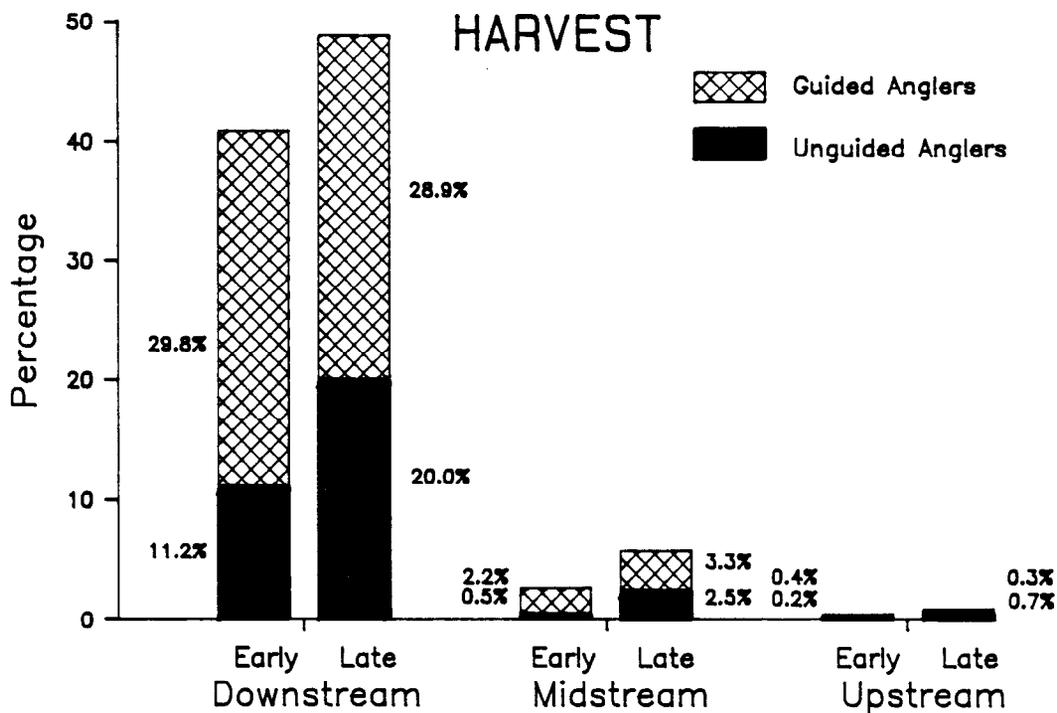
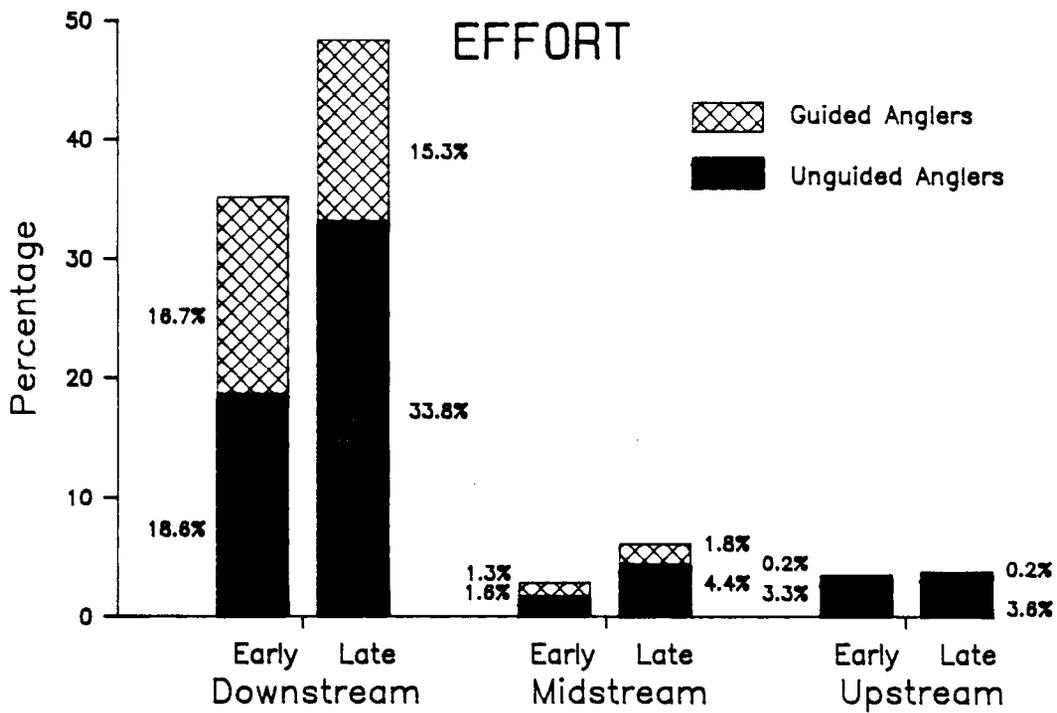


Figure 6. Percent of total angler effort and chinook salmon harvest by guided and unguided anglers for each run and river section of the chinook salmon fishery in the Kenai River, 1989.

Table 15. Age composition of chinook salmon sampled from the harvest during the early and late runs of the fishery for chinook salmon in the Kenai River, 1989.

RUN	Sex		Age Group					Total
			1.1	1.2	1.3	1.4	1.5	
<u>EARLY</u> (n=181) <sup>a</sup>	Male	Percent	1.1	2.8	10.5	30.4	5.0	49.7
	Female	Percent	0.0	0.6	16.0	32.6	1.1	50.3
	Combined	Percent SE	1.1 0.8	3.3 1.3	26.5 2.3	63.0 3.4	6.1 1.8	
<u>LATE</u> (n=96)	Male	Percent	0.0	1.0	4.2	35.4	10.4	51.0
	Female	Percent	0.0	0.0	6.3	36.5	5.2	49.0
	Combined	Percent SE	0.0 0.0	1.0 1.0	10.4 3.1	71.9 4.6	15.6 3.7	

<sup>a</sup> n = sample size.

Table 16. Mean length (mm) by age group of chinook salmon sampled from the harvest during the early and late runs of the fishery for chinook salmon in the Kenai River, 1989.

<u>RUN</u> Sex		Age Group				
		1.1	1.2	1.3	1.4	1.5
<u>EARLY RUN</u>						
Male	Mean Length	548	687	846	1022	1133
	Standard Error	13	22	19	9	20
	Sample Size	2	5	19	55	9
Female	Mean Length		680	875	961	1108
	Standard Error			11	7	13
	Sample Size		1	29	59	2
<u>LATE RUN</u>						
Male	Mean Length		726	937	1042	1149
	Standard Error			77	8	15
	Sample Size		1	4	34	10
Female	Mean Length			918	1025	1080
	Standard Error			23	10	18
	Sample Size			6	35	5

was examined previously by Conrad and Hammarstrom (1987) and found to be valid in 1985 and 1986. This assumption was examined again in 1989 for the downstream section only during the chinook salmon fishery. This assumption was again found to be generally valid. Guided and unguided anglers interviewed during each stratum were approximately proportional to the estimated effort in each stratum. Survey clerks were saturated during the last 2 weeks of July on both weekdays and weekend days by unguided anglers which accounts for the relatively poor  $r^2$  value (52.6%) associated with the chinook salmon fishery (Appendix F).

The survey for counting unguided anglers in the downstream section of the river during the chinook salmon fishery was designed to minimize the autocorrelation (Cochran 1977) among counts conducted on the same day. In previous years, angler counts were often conducted within 1 or 2 hours of each other (although they were conducted in different periods). Conrad and Hammarstrom (1987) found significant correlations between same-day counts of unguided anglers conducted from 1 to 7 hours apart for the creel survey of the Kenai River in 1986. In 1989, the sampling schedule was designed such there were at least 8 hours between counts on weekdays and 4 hours on weekend/holidays. Only one count was conducted during each period and since estimates for each component were independent, autocorrelation was of no consequence. Linear regressions between succeeding counts were examined for the following periods on the same day (Appendix E): unguided anglers weekdays; A vs C ( $y=57+0.668x$ ,  $r^2=0.705$ ,  $F=31.0$ ,  $p<0.001$ ), C vs E ( $y=10+0.625x$ ,  $r^2=0.746$ ,  $F=35.4$ ,  $p<0.001$ ), and B vs D ( $y=58+0.457x$ ,  $r^2=0.759$ ,  $F=47.1$ ,  $p<0.001$ ), unguided anglers weekend/holidays; A vs B ( $y=214+0.755x$ ,  $r^2=0.468$ ,  $F=17.7$ ,  $p<0.001$ ), B vs C ( $y=67+0.690x$ ,  $r^2=0.661$ ,  $F=38.9$ ,  $p<0.001$ ), C vs D ( $y=65+0.729x$ ,  $r^2=0.593$ ,  $F=29.1$ ,  $p<0.001$ ), D vs E ( $y=34+0.554x$ ,  $r^2=0.401$ ,  $F=13.1$ ,  $p=0.002$ ), and guided anglers; A vs B ( $y=40+0.604x$ ,  $r^2=0.629$ ,  $F=62.8$ ,  $p<0.001$ ). The strong correlation in angler counts between periods within a day suggests that a systematic sampling design should be implemented to investigate within-period variability in angler counts.

Completed trip angler interviews were conducted at only seven of the numerous possible locations where anglers enter and leave the fishery. The assumption that anglers using the seven exit sites are representative of interview data from other exit sites was tested by Hammarstrom (1988).

#### Coho Salmon Creel Survey

During the coho salmon fishery, 37 of the 61 days possible during the survey period were sampled in the downstream section of the Kenai River. In the upstream section, 42 of the 61 days possible were surveyed.

#### Effort:

Two angler counts were usually conducted on each sample day in the downstream section; there were 3 days when only one angler count was conducted. Two angler counts were conducted on all but 3 days surveyed in the upstream section.

Downstream Section. Angler counts in the downstream section ranged from 5 to 506 for unguided boat anglers, from 8 to 206 for shore anglers, and from 0 to 211 for guided anglers (Appendices C1 and C2). The largest count for all components occurred on 12 August. For each period (except period D in the early run), the mean count of unguided boat anglers, shore anglers and guided anglers for the weekend/holiday component was larger than the mean count for the weekday component (Table 17).

The estimated effort during the early run (August) was 141,155 angler-hours (Table 18). During the early run, 74% of the total effort was by unguided anglers (shore anglers are assumed to be unguided). Anglers fishing on weekdays accounted for 62% of the effort while weekend/holiday anglers accounted for 38% of the effort. The estimated effort during the late run (September) was 66,342 angler-hours (Table 18). The majority of this effort (74%) was by unguided anglers. Also, 47% of the effort occurred during weekdays and 53% during weekends/holidays.

Upstream Section. Angler counts in the upstream section ranged from 0 to 223 for unguided anglers and from 0 to 22 for guided anglers (Appendix C3). The largest count of unguided anglers occurred on 5 August and the largest count of guided anglers on 17 August. For each period in both runs, the mean count of unguided anglers for the weekend/holiday component was larger than the mean count for the weekday component (Table 19). However, the opposite was generally true for guided anglers.

The estimated effort during the early run was 22,312 angler-hours (Table 20). During the early run, 89% of the total effort was by unguided anglers; 56% of the effort occurred during weekdays and 44% during weekends/holidays. The estimated effort during the late run was 13,636 angler-hours (Table 20). The majority of this effort (92%) was by unguided anglers, also.

Midstream Section. A total of 14 flights were conducted to count anglers in each section of the Kenai River between Skilak Lake and Cook Inlet (Table 21). The mean proportion of effort in the midstream section for the early run was 0.037 (SE = 0.018) and the late run was 0.034 (SE = 0.012). Each effort component was expanded accordingly to estimate the midstream component. Estimated effort occurring in the midstream section during the early and late runs was 6,190 angler-hours and 2,858 angler-hours, respectively.

#### Harvest Rates and Catch Rates:

A total of 1,977 angler interviews (both completed trip and incompleting trip) were collected during the creel survey in the downstream section of the Kenai River; 1,121 during the early run and 856 during the late run. In the upstream section, 2,944 angler interviews were collected, 1,432 during the early run and 1,512 during the late run.

Downstream Section. Daily harvest rates of coho salmon by unguided boat anglers ranged from 0.023 to 0.714 fish per hour during the early run and from 0.067 to 0.380 fish per hour during the late run (Appendices D1 and D2). Peak daily catch rates of coho salmon by unguided anglers occurred on 28 August during the early run and on 27 September during the late run

Table 17. Mean counts of anglers by period for each of the components for the creel survey of the fishery for coho salmon in the downstream section of the Kenai River, 1989.

Component	Period			
	A	B	C	D
<u>EARLY RUN</u>				
Unguided boat anglers weekdays:				
Number of counts	8	8	8	3
Mean count	85.8	116.8	110.5	123.7
Standard error	22.1	22.7	15.4	22.7
Unguided boat anglers weekends:				
Number of counts	4	3	4	4
Mean count	281.3	342.7	228.8	110.8
Standard error	28.1	78.9	101.2	36.9
Guided anglers weekdays:				
Number of counts	8	8	8	3
Mean count	121.0	81.6	42.3	20.3
Standard error	17.2	18.7	7.5	2.6
Guided anglers weekends:				
Number of counts	4	3	4	4
Mean count	146.0	157.3	57.8	12.5
Standard error	19.0	29.8	19.0	4.3
Unguided shore anglers weekdays:				
Number of counts	8	8	8	3
Mean count	51.0	68.0	76.4	54.3
Standard error	11.9	9.8	7.6	11.8
Unguided shore anglers weekends:				
Number of counts	4	3	4	4
Mean count	70.8	96.0	117.3	54.3
Standard error	11.8	14.2	37.8	20.1

-Continued-

Table 17. (Page 2 of 2).

Component	Period		
	A	B	C
<u>LATE RUN</u>			
Unguided anglers weekdays:			
Number of counts	5	5	6
Mean count	90.4	53.6	48.8
Standard error	18.8	3.0	10.8
Unguided anglers weekends:			
Number of counts	3	5	5
Mean count	213.7	181.6	127.4
Standard error	15.0	24.9	32.5
Guided anglers weekdays:			
Number of counts	5	5	6
Mean count	64.6	29.2	19.5
Standard error	20.2	5.1	2.7
Guided anglers weekends:			
Number of counts	3	5	5
Mean count	102.0	72.6	22.6
Standard error	25.7	16.8	9.9
Unguided shore anglers weekdays:			
Number of counts	5	5	6
Mean count	38.8	26.2	25.5
Standard error	4.5	4.9	4.5
Unguided shore anglers weekends:			
Number of counts	3	5	5
Mean count	55.0	53.6	42.6
Standard error	9.2	5.1	7.6

Table 18. Estimated number of angler-hours of fishing effort during each of the components of the fishery for coho salmon in the downstream section of the Kenai River, 1989.

<u>Component</u>	<u>Estimated Effort</u>	<u>Standard Error</u>	<u>95% Confidence Interval</u>	<u>Relative Precision</u>
<u>EARLY RUN</u>				
Unguided weekdays	40,173	3,855	32,617 - 47,729	18.8%
Unguided weekends	30,829	4,365	22,274 - 39,384	27.8%
Guided weekdays	24,400	2,450	19,598 - 29,202	19.7%
Guided weekends	11,955	1,292	9,423 - 14,487	21.2%
Unguided shore wd <sup>a</sup>	22,974	1,918	19,215 - 26,733	16.4%
Unguided shore we <sup>b</sup>	10,824	1,492	7,899 - 13,749	27.0%
Sub-totals:				
Unguided anglers	71,002	5,824	59,588 - 82,416	16.1%
Guided anglers	36,355	2,770	30,926 - 41,784	14.9%
Shore anglers	33,798	2,430	29,035 - 38,561	14.1%
Early Run Total	141,155	6,891	127,648 - 154,662	9.6%
<u>LATE RUN</u>				
Unguided weekdays	15,195	1,751	11,763 - 18,627	22.2%
Unguided weekends	20,907	1,744	17,488 - 24,326	16.4%
Guided weekdays	9,064	1,682	5,767 - 12,361	36.4%
Guided weekends	7,888	1,290	5,360 - 10,416	32.0%
Unguided shore wd <sup>a</sup>	7,240	641	5,984 - 8,496	17.3%
Unguided shore we <sup>b</sup>	6,048	520	5,028 - 7,068	16.9%
Sub-totals:				
Unguided anglers	36,102	2,472	31,258 - 40,946	13.4%
Guided anglers	16,952	2,120	12,798 - 21,106	24.5%
Shore anglers	13,288	825	11,670 - 14,906	12.2%
Late Run Total	66,342	3,359	59,759 - 72,925	9.9%
<u>BOTH RUNS COMBINED</u>				
Unguided anglers <sup>c</sup>	154,190	6,828	140,807 - 167,753	8.7%
Guided anglers	53,307	3,488	46,471 - 60,143	12.8%
GRAND TOTAL	207,497	7,667	192,469 - 222,525	7.2%

<sup>a</sup> wd = weekday.

<sup>b</sup> we = weekend.

<sup>c</sup> includes shore anglers.

Table 19. Mean counts of anglers by period for each of the components for the creel survey of the fishery for coho salmon in the upstream section of the Kenai River, 1989.

Component	Period			
	A	B	C	D
<u>EARLY RUN</u>				
Unguided anglers weekdays:				
Number of counts	8	11	8	3
Mean count	17.3	45.8	37.1	14.0
Standard error	7.1	9.3	6.5	4.4
Unguided anglers weekends:				
Number of counts	3	4	4	3
Mean count	38.7	116.3	78.8	59.3
Standard error	22.2	38.2	10.3	22.9
Guided anglers weekdays:				
Number of counts	8	11	8	3
Mean count	2.6	10.9	7.3	0.0
Standard error	1.5	1.7	1.9	0.0
Guided anglers weekends:				
Number of counts	3	4	4	3
Mean count	2.0	10.0	2.5	1.7
Standard error	1.0	1.5	1.7	1.7
<u>LATE RUN</u>				
Unguided anglers weekdays:				
Number of counts	6	9	7	
Mean count	28.8	26.1	22.1	
Standard error	7.1	4.4	3.9	
Unguided anglers weekends:				
Number of counts	5	6	5	
Mean count	45.8	71.0	43.4	
Standard error	11.4	4.7	4.2	
Guided anglers weekdays:				
Number of counts	6	9	7	
Mean count	2.7	3.3	0.6	
Standard error	1.4	0.9	0.5	
Guided anglers weekends:				
Number of counts	5	6	5	
Mean count	7.2	6.8	0.0	
Standard error	4.2	2.6	0.0	

Table 20. Estimated number of angler-hours of fishing effort during each of the components of the fishery for coho salmon in the upstream section of the Kenai River, 1989.

Component	Estimated Effort	Standard Error	95% Confidence Interval	Relative Precision
<u>EARLY RUN</u>				
Unguided weekdays	10,506	1,297	7,963 - 13,049	24.2%
Unguided weekends	9,376	1,628	6,186 - 15,566	34.0%
Guided weekdays	1,913	271	1,383 - 2,443	27.7%
Guided weekends	517	94	332 - 702	35.8%
Sub-totals:				
Unguided anglers	19,882	2,081	18,802 - 23,962	20.5%
Guided anglers	2,430	287	1,868 - 2,992	23.1%
Early Run Total	22,312	2,101	18,194 - 26,430	18.5%
<u>LATE RUN</u>				
Unguided weekdays	6,167	739	4,719 - 7,615	23.5%
Unguided weekends	6,408	523	5,384 - 7,432	16.0%
Guided weekdays	526	145	241 - 811	54.1%
Guided weekends	535	199	145 - 925	72.9%
Sub-totals:				
Unguided anglers	12,575	905	10,802 - 14,348	14.1%
Guided anglers	1,061	247	578 - 1,544	45.5%
Late Run Total	13,636	938	11,798 - 15,474	13.5%
<u>BOTH RUNS COMBINED</u>				
Unguided anglers	32,457	2,269	28,010 - 36,904	13.7%
Guided anglers	3,491	379	2,749 - 4,233	21.3%
GRAND TOTAL	35,948	2,300	31,439 - 40,457	12.5%

Table 21. Counts of sportfishing boats by river section conducted during aerial surveys of the fishery for coho salmon in the Kenai River, 1989.

Date	<u>Downstream</u>		<u>Midstream</u>		<u>Upstream</u>		Total Count
	Count	Pro. <sup>a</sup>	Count	Pro. <sup>a</sup>	Count	Pro. <sup>a</sup>	
<u>EARLY RUN</u>							
8/04	49	0.778	4	0.063	10	0.159	63
8/05	104	0.794	7	0.053	20	0.153	131
8/11	112	0.824	3	0.022	21	0.154	136
8/13	196	0.824	7	0.029	35	0.147	238
8/16	137	0.867	4	0.025	17	0.108	158
8/20	89	0.748	4	0.034	26	0.219	119
8/22	46	0.793	3	0.052	9	0.155	58
8/31	54	0.720	1	0.013	20	0.267	75
Mean		0.793		0.037		0.170	
Standard Error		0.046		0.018		0.049	
<u>LATE RUN</u>							
9/03	59	0.557	2	0.019	45	0.424	106
9/10	54	0.667	3	0.037	24	0.296	81
9/15	84	0.771	5	0.046	20	0.184	109
9/16	145	0.701	10	0.048	52	0.251	207
9/21	29	0.659	1	0.023	14	0.318	44
9/25	13	0.448	1	0.034	15	0.517	29
Mean		0.634		0.034		0.332	
Standard Error		0.114		0.012		0.121	

<sup>a</sup> Proportion of total count.

(Figure 7). Daily harvest rates of coho salmon by guided anglers ranged from 0.028 to 0.487 fish per hour during the early run and from 0.067 to 0.380 fish per hour during the late run (Appendix D2). Peak daily catch rates by guided anglers occurred on 9 August during the early run and on 13 September during the late run (Figure 7). The highest mean harvest rate among all components of the fishery was for guided anglers on weekdays of the late run (Table 22). The highest harvest and catch rate for the entire coho salmon fishery was realized by shore anglers (0.571) on 25 August (Appendix D3).

Other species in the downstream section are considered incidental during the fishery for coho salmon except for pink salmon (Table 23).

Upstream Section. Daily harvest rates of coho salmon by unguided anglers ranged from 0.000 to 0.238 fish per hour during the early run and from 0.095 to 0.388 fish per hour during the late run (Appendix D4). Peak daily catch rates of coho salmon by unguided anglers occurred on 28 August during the early run and on 15 September during the late run. Daily harvest rates of coho salmon by guided anglers ranged from 0.000 to 0.625 fish per hour during the early run and from 0.000 to 1.167 fish per hour during the late run (Appendix D5). Peak daily catch rates of coho salmon by guided anglers occurred on 14 August during the early run and on 1 and 25 September during the late run. Harvest and catch rates of coho salmon by guided anglers were generally greater than those for unguided anglers during both runs (Table 24).

In the upstream section, other species were more significant to the recreational harvest of both guided and unguided anglers than in the downstream section, as can be attested to by the comparatively larger harvest and catch rates, especially for sockeye salmon (Table 25).

#### Harvest and Catch:

Harvest and catch of coho salmon by shore and boat anglers were estimated for each component in the downstream and upstream sections of the Kenai River. Estimated effort and catch rates for each component from Tables 18 and 22, respectively, were used to estimate harvest and catch in the downstream section. For the upstream section, estimated effort and catch rates for each component from Tables 20 and 24, respectively, were used to estimate harvest and catch.

Downstream Section. An estimated 37,403 coho salmon were harvested by anglers in the downstream section: 24,278 fish (65%) during the early run and 13,125 fish (35%) during the late run (Table 26). Unguided anglers harvested 24,881 coho salmon (67% of the total) and guided anglers harvested 12,522 fish (33% of the total). The total coho salmon catch by anglers in the downstream section was 37,694 fish: 24,425 fish (65%) during the early run and 13,269 fish (35%) during the late run (Table 26). Unguided anglers released only 1% of their coho salmon catch while guided anglers did not release any of their catch.

Upstream Section. An estimated 4,573 coho salmon were harvested by anglers in the upstream section: 2,065 fish (45%) during the early run and 2,508

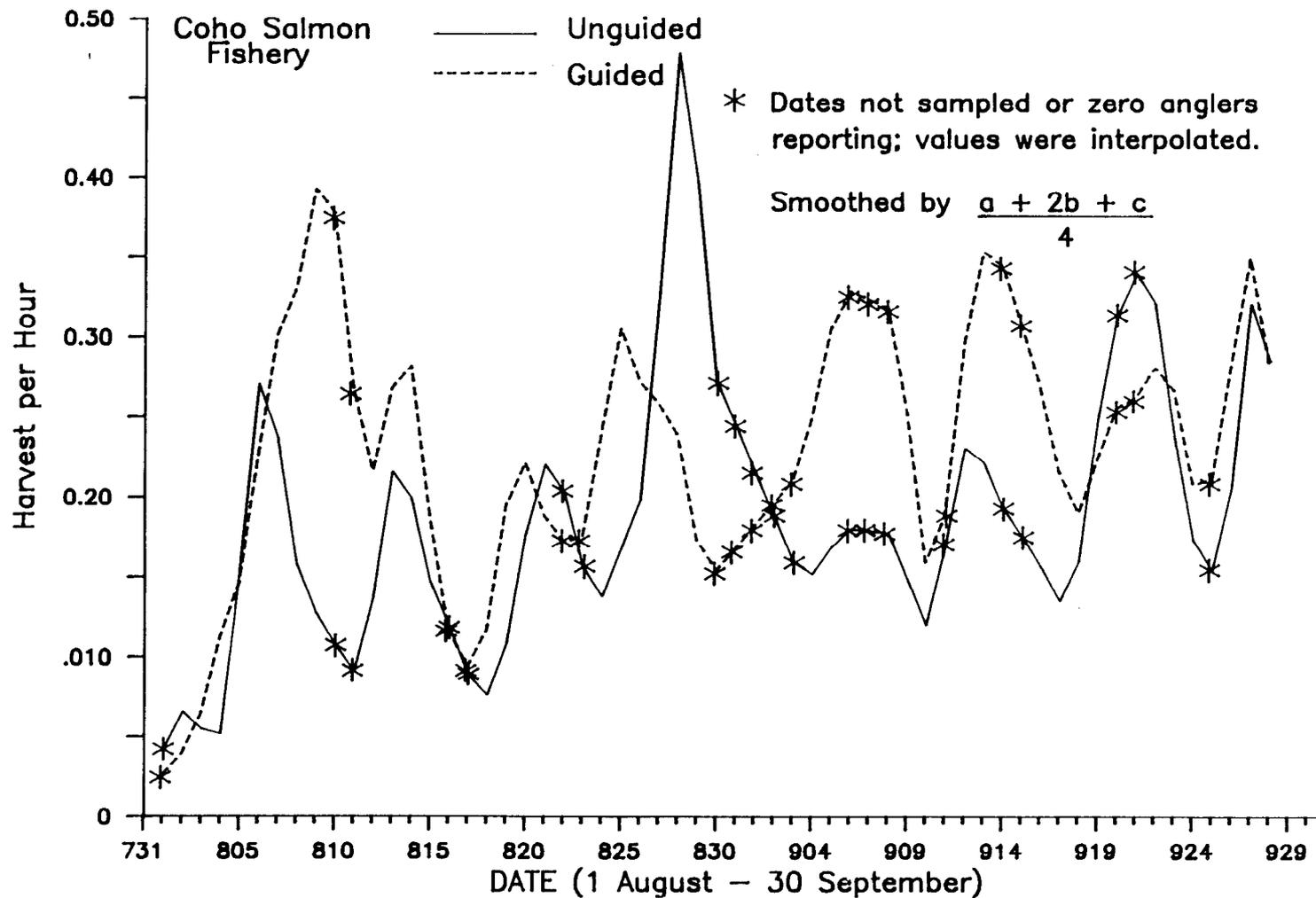


Figure 7. Daily harvest per hour of coho salmon by guided and unguided anglers in the recreational fishery for coho salmon in the downstream section of the Kenai River, 1989.

Table 22. Estimated harvest per unit effort (HPUE) and catch per unit effort (CPUE) of coho salmon by anglers during each of the components of the fishery for coho salmon in the downstream section of the Kenai River, 1989.

Component	Days		Number of Interviews <sup>c</sup>	Harvest HPUE	Standard Error	Catch CPUE	Standard Error
	n <sup>a</sup>	N <sup>b</sup>					
<u>EARLY RUN</u>							
Unguided weekdays	14	23	251	0.1451	0.03511	0.1479	0.03634
Unguided weekends	8	8	305	0.1693	0.01921	0.1704	0.01926
Guided weekdays	14	23	333	0.2288	0.02647	0.2288	0.02647
Guided weekends	8	8	182	0.1937	0.02952	0.1937	0.02952
Shore weekdays	10	23	35	0.1951	0.05013	0.1951	0.05013
Shore weekends	3	8	15	0.0784	0.04236	0.0784	0.04236
<u>LATE RUN</u>							
Unguided weekdays	8	20	216	0.2360	0.03050	0.2374	0.03033
Unguided weekends	7	10	294	0.1467	0.01756	0.1526	0.01822
Guided weekdays	8	20	166	0.3004	0.03125	0.3004	0.03125
Guided weekends	7	10	115	0.2409	0.03237	0.2409	0.03237
Shore weekday	5	20	26	0.1656	0.04348	0.1656	0.04348
Shore weekends	6	10	39	0.1075	0.02733	0.1075	0.02733

<sup>a</sup> Number of days on which interviews were collected.

<sup>b</sup> Number of days possible for interviewing.

<sup>c</sup> Both completed trip and incompleted trip interviews.

Table 23. Estimated harvest per unit effort (HPUE) and catch per unit effort (CPUE) of sockeye salmon, pink salmon, rainbow trout, and Dolly Varden by anglers during each of the components of the fishery for coho salmon in the downstream section of the Kenai River, 1989.

Component	<u>SOCKEYE SALMON</u>		<u>PINK SALMON</u>		<u>RAINBOW TROUT</u>		<u>DOLLY VARDEN</u>	
	HPUE	CPUE	HPUE	CPUE	HPUE	CPUE	HPUE	CPUE
<u>EARLY RUN</u>								
Unguided weekdays	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0156	0.0256
(Standard Error)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0139)	(0.0176)
Unguided weekends	0.0000	0.0012	0.0000	0.0000	0.0000	0.0000	0.0070	0.0116
(Standard Error)	(0.0000)	(0.0012)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0044)	(0.0085)
Guided weekdays	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0041	0.0066
(Standard Error)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0024)	(0.0038)
Guided weekends	0.0012	0.0012	0.0000	0.0000	0.0000	0.0000	0.0000	0.0012
(Standard Error)	(0.0012)	(0.0012)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0012)
Shore anglers wd <sup>a</sup>	0.0122	0.0122	0.0000	0.0000	0.0000	0.0000	0.0122	0.0122
(Standard Error)	(0.0216)	(0.0216)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0216)	(0.0216)
Shore anglers we <sup>b</sup>	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
(Standard Error)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
<u>LATE RUN</u>								
Unguided weekends	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
(Standard Error)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Unguided weekends	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0020
(Standard Error)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0017)
Guided weekdays	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
(Standard Error)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Guided weekends	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
(Standard Error)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Shore anglers wd <sup>a</sup>	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
(Standard Error)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Shore anglers we <sup>b</sup>	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0072	0.0072
(Standard Error)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0008)	(0.0048)	(0.0048)

<sup>a</sup> wd - weekdays.

<sup>b</sup> we - weekends.

Table 24. Estimated harvest per unit effort (HPUE) and catch per unit effort (CPUE) of coho salmon by anglers during each of the components of the fishery for coho salmon in the upstream section of the Kenai River, 1989.

Component	Days		Number of Interviews <sup>c</sup>	Harvest HPUE	Standard Error	Catch CPUE	Standard Error
	n <sup>a</sup>	N <sup>b</sup>					
<u>EARLY RUN</u>							
Unguided weekdays	15	23	568	0.0788	0.01312	0.0813	0.01329
Unguided weekends	7	8	657	0.0802	0.01308	0.0822	0.01332
Guided weekdays	14	23	149	0.2210	0.04013	0.2255	0.04059
Guided weekends	6	8	58	0.1203	0.03997	0.1203	0.03997
<u>LATE RUN</u>							
Unguided weekdays	11	20	536	0.2211	0.02049	0.2258	0.02216
Unguided weekends	9	10	844	0.1314	0.00971	0.1420	0.01029
Guided weekdays	10	20	59	0.4364	0.05971	0.4727	0.08529
Guided weekends	6	10	73	0.1355	0.03868	0.1355	0.03868

<sup>a</sup> Number of days on which interviews were collected.

<sup>b</sup> Number of days possible for interviewing.

<sup>c</sup> Both completed trip and incompleted trip interviews.

Table 25. Estimated harvest per unit effort (HPUE) and catch per unit effort (CPUE) of sockeye salmon, pink salmon, rainbow trout, and Dolly Varden by anglers during each of the components of the fishery for coho salmon in the upstream section of the Kenai River, 1989.

Component	<u>SOCKEYE SALMON</u>		<u>PINK SALMON</u>		<u>RAINBOW TROUT</u>		<u>DOLLY VARDEN</u>	
	HPUE	CPUE	HPUE	CPUE	HPUE	CPUE	HPUE	CPUE
<u>EARLY RUN</u>								
Unguided weekdays	0.1039	0.2296	0.0008	0.0034	0.0109	0.0302	0.0905	0.2564
(Standard Error)	(0.0240)	(0.0482)	(0.0007)	(0.0020)	(0.0040)	(0.0081)	(0.0177)	(0.0427)
Unguided weekends	0.0802	0.2198	0.0000	0.0060	0.0027	0.0261	0.0688	0.2425
(Standard Error)	(0.0165)	(0.0389)	(0.0000)	(0.0023)	(0.0027)	(0.0086)	(0.0083)	(0.0322)
Guided weekdays	0.0501	0.1595	0.0023	0.0046	0.0000	0.0296	0.0706	0.1458
(Standard Error)	(0.0119)	(0.0430)	(0.0022)	(0.0037)	(0.0000)	(0.0119)	(0.0219)	(0.0395)
Guided weekends	0.0688	0.2923	0.0000	0.0057	0.0000	0.0172	0.1261	0.2521
(Standard Error)	(0.0252)	(0.0806)	(0.0000)	(0.0069)	(0.0000)	(0.0110)	(0.0358)	(0.0723)
<u>LATE RUN</u>								
Unguided weekdays	0.0000	0.0190	0.0000	0.0000	0.0028	0.0133	0.0180	0.1224
(Standard Error)	(0.0000)	(0.0071)	(0.0000)	(0.0000)	(0.0016)	(0.0046)	(0.0060)	(0.0228)
Unguided weekends	0.0000	0.0253	0.0000	0.0000	0.0079	0.0232	0.0749	0.2607
(Standard Error)	(0.0000)	(0.0068)	(0.0000)	(0.0000)	(0.0029)	(0.0042)	(0.0129)	(0.0348)
Guided weekdays	0.0000	0.0000	0.0000	0.0000	0.0000	0.0121	0.0242	0.0242
(Standard Error)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0075)	(0.0138)	(0.0138)
Guided weekends	0.0000	0.0956	0.0000	0.0000	0.0000	0.0040	0.1275	0.2351
(Standard Error)	(0.0000)	(0.0302)	(0.0000)	(0.0000)	(0.0000)	(0.0032)	(0.0575)	(0.1068)

Table 26. Estimated number of coho salmon harvested and number caught by anglers during each of the components in the fishery for coho salmon in the downstream section of the Kenai River, 1989.

Component	Harvest <sup>a</sup>	Standard Error	Rel. Pre. <sup>b</sup>	Catch <sup>c</sup>	Standard Error	Rel. Pre. <sup>b</sup>
<u>EARLY RUN</u>						
Unguided weekdays	5,829	1,511	50.8%	5,942	1,561	51.5%
Unguided weekends	5,219	943	35.4%	5,253	948	35.4%
Guided weekdays	5,583	853	29.9%	5,583	853	29.9%
Guided weekends	2,316	431	36.5%	2,316	431	36.5%
Shore weekdays	4,482	1,207	52.8%	4,482	1,207	52.8%
Shore weekends	849	469	108.3%	849	469	108.3%
Sub-totals:						
Unguided	16,379	2,202	26.4%	16,526	2,238	26.6%
Guided	7,899	955	23.7%	7,899	955	23.7%
Early Run Total	24,278	2,401	19.4%	24,425	2,434	19.5%
<u>LATE RUN</u>						
Unguided weekdays	3,586	619	33.8%	3,607	618	33.6%
Unguided weekends	3,067	446	28.5%	3,190	464	28.5%
Guided weekdays	2,723	577	41.5%	2,723	577	41.5%
Guided weekends	1,900	400	41.3%	1,900	400	41.5%
Shore weekdays	1,199	331	54.1%	1,199	331	54.1%
Shore weekends	650	174	52.4%	650	174	52.4%
Sub-totals:						
Unguided	8,502	850	19.6%	8,646	859	19.5%
Guided	4,623	702	29.8%	4,623	702	29.8%
Late Run Total	13,125	1,102	16.5%	13,269	1,109	16.4%
<u>BOTH RUNS COMBINED</u>						
Unguided	24,881	2,360	18.6%	25,172	2,398	18.7%
Guided	12,522	1,185	18.5%	12,522	1,185	18.5%
GRAND TOTAL	37,403	2,642	13.8%	37,694	2,675	13.9%

<sup>a</sup> Harvest includes only fish kept.

<sup>b</sup> Relative precision for 95% confidence interval.

<sup>c</sup> Catch includes fish kept and fish reported as released.

fish (55%) during the late run (Table 27). Unguided anglers harvested 3,786 coho salmon (83% of the total) and guided anglers harvested 787 fish (17% of the total). The total coho salmon catch by anglers in the upstream section was 4,742 fish: 2,118 fish (45%) during the early run and 2,624 fish (55%) during the late run (Table 27). Unguided anglers released 4% of their coho salmon catch while guided anglers released 3% of their catch.

Midstream Section. An estimated 1,425 coho salmon were harvested by anglers in the upstream section: 863 fish (61%) during the early run and 562 fish (39%) during the late run.

Other Species. The estimates of harvest and catch of species other than coho salmon for the downstream and upstream sections are summarized in Tables 28 and 29, respectively.

#### Summary:

The estimated total angler-effort in the Kenai River during the coho salmon fishery was 252,493 angler-hours (Table 30). Estimated total harvest and catch of coho salmon during the coho salmon fishery were 43,401 fish and 43,886 fish, respectively (Table 30). Based on information collected from the downstream and upstream sections, unguided anglers exerted 76.7% of the effort and harvested 68.2% of the coho salmon while guided anglers exerted 23.3% of the effort and harvested 31.8% of the fish. The majority of the effort (82.2%) and coho salmon harvest (86.2%) were estimated to occur in the downstream section of the fishery (Figure 8). In contrast to the chinook salmon fishery, where an estimated 26% of the chinook salmon caught by anglers were released, only 1% of the coho salmon caught were released.

#### Biological Data:

The most abundant age groups in the early run harvest were ages 2.1 and 3.1 coho salmon which composed 79.7% and 16.1% of the sample, respectively (Table 31). Ages 2.1 and 3.1 coho salmon were the most abundant age groups in the late run harvest, also, contributing 70.3% and 27.2% to the sample, respectively (Table 31). The mean lengths at age for each sex were greater in late run fish than in early run fish for all age groups (Table 32).

#### Discussion:

The assumption was made that incompleting trip interviews provide an unbiased estimate of harvest rate. Conrad and Hammarstrom (1987) concluded that incompleting trip interviews may not provide an unbiased estimate but the number of completed trip interviews was quite small. This was also the case during 1989 in that very few completed trip interviews were collected by the roving boat survey clerks and no comparison was attempted.

The assumption that interviews were collected in proportion to effort was also examined in 1986 (Conrad and Hammarstrom 1987) and concluded to be met. This assumption was examined again in 1989 for both downstream and upstream sections during the coho salmon fishery. This assumption was again found to be generally valid. Guided and unguided anglers interviewed during each

Table 27. Estimated number of coho salmon harvested and number caught by anglers during each of the components in the fishery for coho salmon in the upstream section of the Kenai River, 1989.

Component	Harvest <sup>a</sup>	Standard Error	Rel. Pre. <sup>b</sup>	Catch <sup>c</sup>	Standard Error	Rel. Pre. <sup>b</sup>
<u>EARLY RUN</u>						
Unguided weekdays	828	171	40.4%	854	174	40.0%
Unguided weekends	752	180	46.4%	771	182	46.2%
Guided weekdays	423	97	44.8%	431	98	44.6%
Guided weekends	62	23	73.6%	62	23	73.6%
Sub-totals:						
Unguided	1,580	247	30.6%	1,625	252	30.4%
Guided	485	100	40.2%	493	101	40.1%
Early Run Total	2,065	266	25.2%	2,118	271	25.1%
<u>LATE RUN</u>						
Unguided weekdays	1,364	206	29.6%	1,393	215	30.3%
Unguided weekends	842	93	21.5%	910	99	21.3%
Guided weekdays	230	70	59.8%	249	81	63.8%
Guided weekends	72	33	90.1%	72	33	90.1%
Sub-totals:						
Unguided	2,206	226	20.1%	2,303	237	20.1%
Guided	302	78	50.4%	321	88	53.5%
Late Run Total	2,508	239	18.7%	2,624	252	18.9%
<u>BOTH RUNS COMBINED</u>						
Unguided	3,786	335	17.3%	3,928	347	17.3%
Guided	787	127	31.6%	814	134	32.3%
GRAND TOTAL	4,573	358	15.3%	4,742	370	15.3%

<sup>a</sup> Harvest includes only fish kept.

<sup>b</sup> Relative precision for 95% confidence interval.

<sup>c</sup> Catch includes fish kept and fish reported as released.

Table 28. Estimated number of sockeye salmon, rainbow trout, and Dolly Varden harvested and caught by anglers during the fishery for coho salmon in the downstream section of the Kenai River, 1989.

Species	<u>Unguided Anglers</u>				<u>Guided Anglers</u>				<u>Shore Anglers</u>			
	Harv. <sup>a</sup>	SE	Catch <sup>b</sup>	SE	Harv. <sup>a</sup>	SE	Catch <sup>b</sup>	SE	Harv. <sup>a</sup>	SE	Catch <sup>b</sup>	SE
<u>EARLY RUN</u>												
Sockeye salmon	0	0	37	36	14	15	14	15	280	495	280	495
Dolly Varden	843	577	1,666	760	100	60	175	94	280	495	280	495
<u>LATE RUN</u>												
Dolly Varden	0	0	42	36	0	0	0	0	44	29	44	29

<sup>a</sup> Harvest includes only fish kept.

<sup>b</sup> Catch includes fish kept and fish reported as released.

Table 29. Estimated number of sockeye salmon, rainbow trout, and Dolly Varden harvested and caught by anglers during the fishery for coho salmon in the upstream section of the Kenai River, 1989.

Species	<u>Unguided Anglers</u>				<u>Guided Anglers</u>			
	Harvest <sup>a</sup>	SE	Catch <sup>b</sup>	SE	Harvest <sup>a</sup>	SE	Catch <sup>b</sup>	SE
<u>EARLY RUN</u>								
Sockeye salmon	1,850	350	4,488	777	132	42	456	251
Pink salmon	8	8	92	32	4	4	12	8
Rainbow trout	140	90	564	130	0	0	66	25
Dolly Varden	1,602	259	4,985	752	200	51	409	95
<u>LATE RUN</u>								
Sockeye salmon	0	0	279	64	0	0	51	24
Rainbow trout	68	21	231	42	0	0	8	18
Dolly Varden	591	99	2,426	309	80	39	138	71

<sup>a</sup> Harvest includes only fish kept.

<sup>b</sup> Catch includes fish kept and fish reported as released.

Table 30. Summary of estimated angler-effort, coho salmon harvest, and coho salmon catch by all anglers for each river section of the fishery for coho salmon in the Kenai River, 1989.

Run	Downstream Section	Upstream Section	Midstream Section	Total	95% Confidence Interval
<u>Early Run</u>					
Effort	141,155	22,312	6,190	169,657	154,718 - 184,596
SE	6,891	2,101	2,489	7,622	
Harvest	24,278	2,065	863	27,206	22,427 - 31,985
SE	2,401	266	332	2,438	
Catch	24,425	2,118	874	27,417	22,572 - 32,262
SE	2,434	271	336	2,472	
<u>Late Run</u>					
Effort	66,342	13,636	2,858	82,836	75,808 - 89,864
SE	3,359	938	833	3,586	
Harvest	13,125	2,508	562	16,195	13,963 - 18,427
SE	1,102	239	160	1,139	
Catch	13,269	2,624	576	16,469	14,217 - 18,721
SE	1,109	252	164	1,149	
<u>Total Both Runs</u>					
Effort	207,497	35,948	9,048	252,493	235,983 - 269,002
SE	7,666	2,301	2,625	8,423	
Harvest	37,403	4,573	1,425	43,401	38,126 - 48,676
SE	2,642	358	369	2,691	
Catch	37,694	4,742	1,450	43,886	38,543 - 49,229
SE	2,675	370	458	2,726	

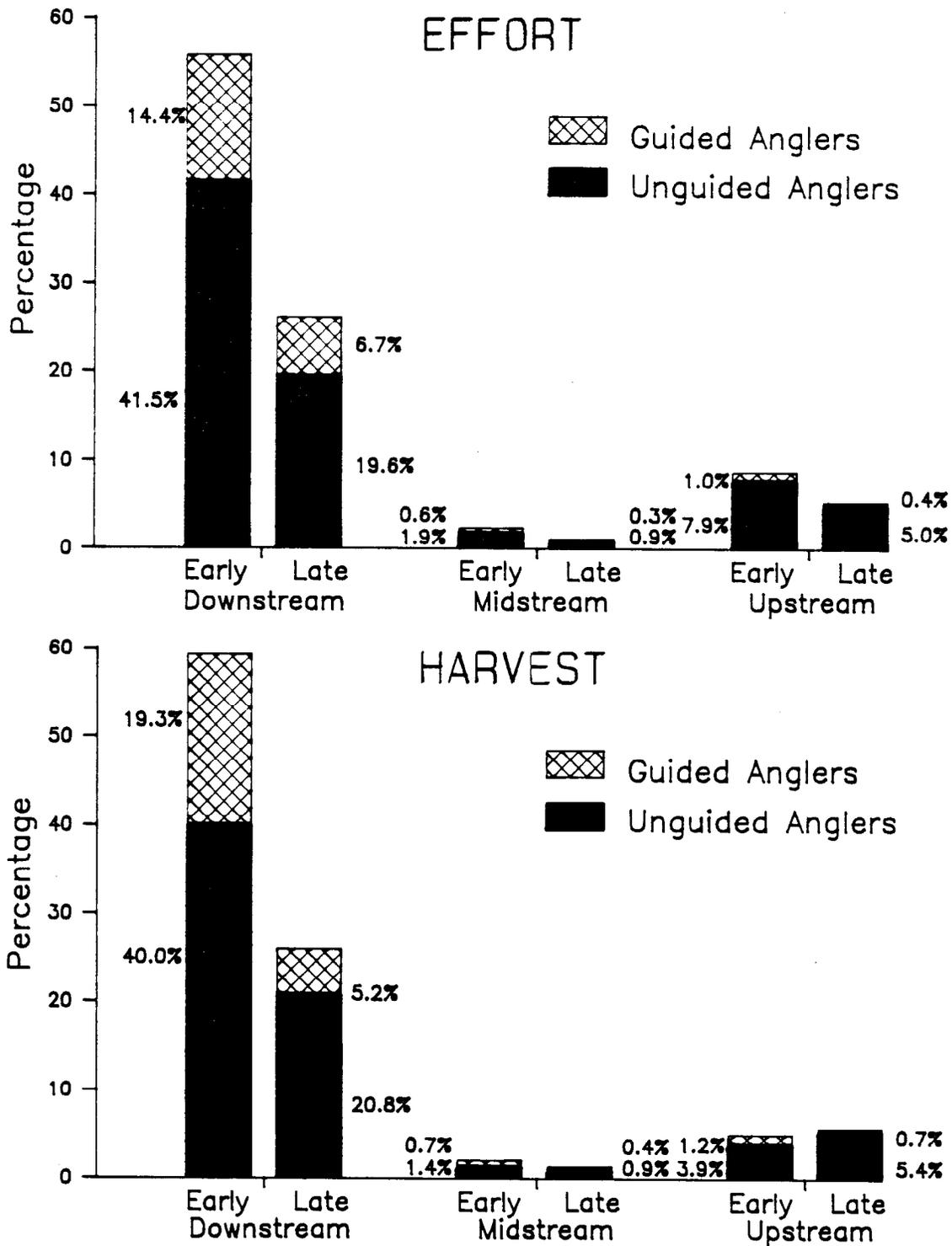


Figure 8. Percent of total angler-effort and coho salmon harvest by guided and unguided anglers for each run and river section of the coho salmon fishery in the Kenai River, 1989.

Table 31. Age composition of coho salmon sampled from the harvest during the early and late runs of the fishery for coho salmon in the Kenai River, 1989.

RUN	Sex		Age Group			Total
			1.1	2.1	3.1	
<u>EARLY</u> (n=118) <sup>a</sup>	Male	Percent	1.7	40.7	8.5	50.8
	Female	Percent	2.5	39.0	7.6	49.2
	Combined	Percent SE	4.2 1.86	79.7 3.72	16.1 3.40	
<u>LATE</u> (n=158)	Male	Percent	1.9	34.9	13.3	50.1
	Female	Percent	0.6	35.4	13.9	49.9
	Combined	Percent SE	2.5 1.25	70.3 3.65	27.2 3.53	

<sup>a</sup> n = sample size.

Table 32. Mean length (mm) by age group of coho salmon sampled from the harvest during the early and late runs of the fishery for coho salmon in the Kenai River, 1989.

<u>Run</u>		<u>Age Group</u>		
		1.1	2.1	3.1
<u>Sex</u>				
<u>EARLY RUN</u>				
Male	Mean Length	495	583	627
	Standard Error	5	7	12
	Sample Size	2	48	10
Female	Mean Length	546	580	607
	Standard Error	12	6	11
	Sample Size	3	46	9
<u>LATE RUN</u>				
Male	Mean Length	563	616	637
	Standard Error	13	6	11
	Sample Size	3	59	21
Female	Mean Length	600	609	623
	Standard Error		6	9
	Sample Size	1	56	22

stratum were approximately proportional to the estimated effort in both guided strata but not proportional for the unguided strata in either section (Appendix F). Equipment problems accounted for the major discrepancy in the downstream section during the coho salmon fishery as the creel clerk was forced to leave the river before the shift was scheduled to end thus missing angler contacts. No apparent explanation was resolved for the upstream section. The  $r^2$ , F, and p values for each strata are presented in Appendix F.

#### SUMMARY

Creel surveys were conducted from 16 May through 30 September in the downstream section and from 11 June through 30 September in the upstream section of the Kenai River. The estimated total effort by recreational anglers in the Kenai River between the outlet of Skilak Lake and Cook Inlet was 816,012 angler-hours (Table 33). This is a minimum estimate of effort, as it does not include the effort by shore anglers during the period 16 May through 31 July. Most fishing effort occurred in the downstream section of the Kenai River. About 68% of the total effort was by unguided anglers and 32% by guided anglers. More coho salmon were harvested than any other species in the survey area (Table 34), followed by sockeye salmon and chinook salmon. The estimated harvest of sockeye salmon is a minimum estimate because shore-based anglers during late July and the fishery in the midstream section during early August harvest large numbers of this species.

#### RECOMMENDATIONS

Based upon the results of the creel survey conducted in the lower Kenai River in 1989, I recommend the following changes to the sample design and data analyses for 1990.

1. When not conducting angler counts during the chinook salmon fishery, the survey clerks using boats should examine the harvest for tagged-to-untagged ratios for use in the population estimate based on the tagging estimate.
2. Because harvest estimates of chinook salmon for the midstream section have approximated 10% of the total harvest and the upstream harvest has been inconsequential, sampling effort should be shifted to the midstream section. Completed trip angler interviews from the midstream section should be collected to obtain estimates and their associated variances of the harvest and catch rates. Effort in both the upstream and midstream section should be estimated through expansion of aerial surveys.
3. During the late run, chinook salmon harvested from the midstream section should also be examined for tagged-to-untagged ratios.
- 4. The creel survey sampling design for coho salmon should be evaluated in a similar manner as the chinook salmon program has undergone. An emphasis should be placed on gathering more completed

Table 33. Summary of the number of angler-hours of fishing effort estimated for each of the major components of the recreational fishery in the lower Kenai River, 1989.

Component	Estimated Effort	Standard Error
<u>Chinook Salmon Fishery<sup>a</sup></u>		
Early Run - Downstream - Unguided anglers	104,702	4,717
- Guided anglers	93,927	3,373
- Upstream - Unguided anglers	18,453	1,807
- Guided anglers	1,263	282
- Midstream - Unguided anglers	9,127	3,939
- Guided anglers	7,055	3,041
Late Run - Downstream - Unguided anglers	186,382	6,646
- Guided anglers	86,507	3,166
- Upstream - Unguided anglers	20,185	1,829
- Guided anglers	1,065	261
- Midstream - Unguided anglers	24,518	8,853
- Guided anglers	10,394	3,756
Sub-totals:		
Unguided anglers	363,368	12,920
Guided anglers	200,211	6,701
<u>Coho Salmon Fishery</u>		
Early Run - Downstream - Unguided anglers <sup>a</sup>	71,002	5,824
- Guided anglers <sup>a</sup>	36,355	2,770
- Shore anglers	33,798	2,430
- Upstream - Unguided anglers <sup>b</sup>	19,882	2,081
- Guided anglers <sup>a</sup>	2,430	287
- Midstream - Unguided anglers <sup>b</sup>	4,721	2,376
- Guided anglers <sup>a</sup>	1,469	743
Late Run - Downstream - Unguided anglers <sup>a</sup>	36,102	2,472
- Guided anglers <sup>a</sup>	16,952	2,120
- Shore anglers	13,288	825
- Upstream - Unguided anglers <sup>b</sup>	12,575	905
- Guided anglers <sup>a</sup>	1,061	247
- Midstream - Unguided anglers <sup>b</sup>	2,214	797
- Guided anglers <sup>a</sup>	1,469	743
Sub-totals:		
Unguided anglers <sup>b</sup>	193,522	7,612
Guided anglers <sup>a</sup>	58,911	3,595
GRAND TOTAL	816,012	16,814

<sup>a</sup> Estimates are for boat anglers only.

<sup>b</sup> Estimates are for both boat and shore anglers.

Table 34. Estimated harvest and catch of major fish species by anglers during the recreational fisheries surveyed in the lower Kenai River, 1989.

Species	Estimated Harvest	Standard Error	Estimated Catch	Standard Error
Chinook salmon	16,383	779	22,111	1,135
Coho salmon	43,401	2,691	43,886	2,726
Sockeye salmon	24,743	2,093	34,067	2,374
Pink salmon	22	11	196	56
Rainbow trout	763	119	3,881	459
Dolly Varden	8,515	1,912	19,435	1,580

trip interviews during the coho fishery so that a comparison test can be performed between completed trip and incompletd trip interviews. Also, an on-site survey for the midstream section should be implemented.

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APPENDIX A

Counts of boat anglers during the creel survey of the fishery for chinook salmon in the Kenai River, 1989.

Appendix A1. Counts of unguided and guided boat anglers during the fishery for early run chinook salmon in the downstream section of the Kenai River, 1989.

Date	Wd/ We	Unguided Anglers Period					Guided Anglers Period				
		A	B	C	D	E	A	B	C	D	E
5/16	Wd				43				26		
5/17	Wd	14		15		27	10		14		0
5/18	Wd		13		36			31		30	
5/19	Wd	31		29		10	46		40		3
5/20	We	12	95	95	114		6	159	57	92	
5/21	We										
5/22	Wd						CLOSED				
5/23	Wd										
5/24	Wd										
5/25	Wd	15		29		47	11		92		3
5/26	Wd		65		36			143		91	
5/27	We	3	108	79	255	130	0	159	56	111	6
5/28	We	98	272	280	125	104	135	136	108	22	5
5/29	We	9	128	207	86	24	0	124	74	82	4
5/30	Wd		45		48			145		63	
5/31	Wd	35		51			119		93		
6/01	Wd										
6/02	Wd			35		95	93				
6/03	We	36	246	204	345	289	79	183			
6/04	We	166	305	173	195	105	216	143			
6/05	Wd						CLOSED				
6/06	Wd	227		105		94	348	219			
6/07	Wd		229		105		317	169			
6/08	Wd	50				261	313				
6/09	Wd		215		213		342	167			
6/10	We	126	333	375	212	203	350	250			
6/11	We	275	401	225	106	85	279	188			
6/12	Wd						CLOSED				
6/13	Wd		147		132		266	234			
6/14	Wd	37		152		75	122	228			
6/15	Wd		126		125		296	211			
6/16	Wd	125		185		103	290	212			
6/17	We	207	272	243	327	144	311	192			
6/18	We	227	211	177	177	39	257	152			
6/19	Wd						CLOSED				
6/20	Wd					79		197			
6/21	Wd		217		176		397	208			
6/22	Wd	142		105			358	275			
6/23	Wd				178			229			
6/24	We	179	319		253	272	324	217			

-Continued-

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Date	Wd/We	Unguided Anglers					Guided Anglers				
		Period					Period				
		A	B	C	D	E	A	B	C	D	E
6/25	We	47	341	405	384	239	275	241			
6/26	Wd						CLOSED				
6/27	Wd		295				367				
6/28	Wd					145					
6/29	Wd		158		134		253	194			
6/30	Wd	63		125			273	171			

Appendix A2. Counts of unguided and guided boat anglers during the fishery for late run chinook salmon in the downstream section of the Kenai River, 1989.

Date	Wd/ We	Unguided Anglers Period					Guided Anglers Period	
		A	B	C	D	E	A	B
7/01	We	259	252	397	428	209	242	212
7/02	We	429	438	443	462	116	CLOSED TO GUIDES	
7/03	Wd					CLOSED		
7/04	Wd	364	513	240	235	173	381	212
7/05	Wd		211		179		270	164
7/06	Wd	266		210		94	294	222
7/07	Wd		375		207		317	241
7/08	We	292	528	405	374	494	284	192
7/09	We	241	688	613	428	404	CLOSED TO GUIDES	
7/10	Wd					CLOSED		
7/11	Wd		659		313		515	385
7/12	Wd	324		407		231	472	375
7/13	Wd		402		375		446	311
7/14	Wd		395	312		147	456	345
7/15	We	631	588	607	516	254	399	297
7/16	We	111	616	538	569	272	CLOSED TO GUIDES	
7/17	Wd					CLOSED		
7/18	Wd	698		424		436	550	474
7/19	Wd		401		207		477	322
7/20	Wd	348		213		104	430	330
7/21	Wd		476		320		396	312
7/22	We	337	472	478	470	401	429	289
7/23	We	381	641	396	194	160	CLOSED TO GUIDES	
7/24	Wd					CLOSED		
7/25	Wd		668		295		490	401
7/26	Wd	335		319		239	399	269
7/27	Wd		416		292		337	211
7/28	Wd	363		481		264		270
7/29	We		524	365	420		369	200
7/30	We	374	562	415	376	211	CLOSED TO GUIDES	
7/31	Wd					CLOSED		

Appendix A3. Counts of unguided and guided boat anglers during the fishery for early run chinook salmon in the upstream section of the Kenai River, 1989.

Date	Wd/ We	Unguided Anglers					Guided Anglers	
		Period					Period	
		A	B	C	D	E	A	B
6/11	We				9			
6/12	Wd					CLOSED		
6/13	Wd			10				4
6/14	Wd			6				6
6/15	Wd				6			
6/16	Wd	5				23	0	
6/17	We	3	101				13	
6/18	We			72	2			3
6/19	Wd					CLOSED		
6/20	Wd				23	12		2
6/21	Wd	0		20				3
6/22	Wd		19		15		8	
6/23	Wd							
6/24	We		39			50	5	
6/25	We			99	77			2
6/26	Wd					CLOSED		
6/27	Wd							
6/28	Wd	0		61				0
6/29	Wd		33		31		3	
6/30	Wd		34				4	
7/01	We			130		86		14
7/02	We	14	138				CLOSED TO GUIDES	
7/03	Wd					CLOSED		
7/04	We							
7/05	Wd	9				42		
7/06	Wd		17	36			5	3
7/07	Wd				30	27		0
7/08	We	21		126				4
7/09	We			79	42		CLOSED TO GUIDES	
7/10	Wd					CLOSED		

Appendix A4. Counts of unguided and guided boat anglers during the fishery for late run chinook salmon in the upstream section of the Kenai River, 1989.

Date	Wd/ We	Unguided Anglers Period					Guided Anglers Period	
		A	B	C	D	E	A	B
7/11	Wd		32		44		2	
7/12	Wd	24		57			2	8
7/13	Wd							
7/14	Wd							
7/15	We		94			99	9	
7/16	We				74	56	CLOSED TO GUIDES	
7/17	Wd					CLOSED		
7/18	Wd		93	86			16	5
7/19	Wd				35	7		
7/20	Wd							
7/21	Wd	4			54			
7/22	We		111	129			20	7
7/23	We	4		75			CLOSED TO GUIDES	
7/24	Wd					CLOSED		
7/25	Wd		57	71			5	0
7/26	Wd							
7/27	Wd	13	57				0	
7/28	Wd			92	81			6
7/29	We		48	59			6	0
7/30	We	44				15	CLOSED TO GUIDES	
7/31	Wd					CLOSED		

APPENDIX B

Daily summary statistics for fishing effort, harvest rate,  
and catch rate for anglers interviewed during the fishery  
for chinook salmon in the Kenai River, 1989.

Appendix B1. Daily summary statistics for fishing effort, chinook salmon harvest, and chinook salmon catch by unguided anglers interviewed during the early run of the fishery for chinook salmon in the downstream section of the Kenai River, 1989 (completed trip interviews only).

Date	Wd/ We	EFFORT (hrs)			HARVEST			CATCH		
		SS <sup>a</sup>	Mean	SE	Mean	SE	HPUE	Mean	SE	CPUE
516	Wd	20	4.8	0.79	0.05	0.050	0.010	0.05	0.050	0.010
517	Wd	16	2.2	0.15	0.19	0.101	0.085	0.19	0.101	0.085
518	Wd	9	3.4	0.50	0.00	0.000	0.000	0.00	0.000	0.000
519	Wd	5	3.0	0.00	0.00	0.000	0.000	0.00	0.000	0.000
520	We	23	4.0	0.22	0.00	0.000	0.000	0.00	0.000	0.000
521	We	10	4.2	0.27	0.10	0.100	0.024	0.10	0.100	0.024
524	Wd	32	4.2	0.26	0.06	0.043	0.015	0.06	0.043	0.015
525	Wd	6	2.0	0.45	0.00	0.000	0.000	0.00	0.000	0.000
526	Wd	17	2.9	0.39	0.06	0.059	0.021	0.06	0.059	0.021
527	We	24	3.9	0.16	0.00	0.000	0.000	0.00	0.000	0.000
528	We	49	3.3	0.19	0.06	0.035	0.019	0.06	0.035	0.019
529	We	36	3.3	0.22	0.03	0.028	0.008	0.11	0.066	0.033
530	Wd	17	4.3	0.41	0.00	0.000	0.000	0.00	0.000	0.000
531	Wd	2	6.0	0.00	0.00	0.000	0.000	0.00	0.000	0.000
603	We	79	4.6	0.27	0.14	0.039	0.030	0.16	0.042	0.036
604	We	90	4.1	0.26	0.04	0.022	0.011	0.07	0.031	0.016
606	Wd	23	5.4	0.51	0.04	0.043	0.008	0.17	0.102	0.032
607	Wd	24	2.8	0.21	0.50	0.104	0.179	0.58	0.119	0.209
608	Wd	84	4.5	0.28	0.06	0.026	0.013	0.17	0.047	0.037
609	Wd	33	3.2	0.34	0.03	0.030	0.009	0.03	0.030	0.009
610	We	68	4.9	0.38	0.07	0.032	0.015	0.09	0.035	0.018
611	We	82	4.6	0.30	0.07	0.029	0.016	0.07	0.029	0.016
613	Wd	30	3.8	0.25	0.00	0.000	0.000	0.00	0.000	0.000
614	Wd	4	3.0	0.00	0.00	0.000	0.000	0.00	0.000	0.000
615	Wd	26	4.8	0.48	0.00	0.000	0.000	0.12	0.085	0.024
616	Wd	28	4.9	0.65	0.00	0.000	0.000	0.04	0.036	0.007
617	We	46	4.5	0.63	0.02	0.022	0.005	0.04	0.030	0.010
618	We	53	3.3	0.17	0.09	0.041	0.029	0.13	0.047	0.040
620	Wd	63	4.8	0.36	0.22	0.053	0.046	0.37	0.065	0.076
621	Wd	64	4.1	0.23	0.08	0.034	0.019	0.11	0.039	0.027
622	Wd	17	4.4	0.31	0.06	0.059	0.014	0.12	0.081	0.027
623	Wd	43	3.2	0.17	0.19	0.060	0.057	0.21	0.063	0.065
624	We	26	3.9	0.37	0.08	0.053	0.020	0.12	0.064	0.029
625	We	101	4.3	0.25	0.04	0.020	0.009	0.04	0.020	0.009
627	Wd	27	5.3	0.38	0.11	0.062	0.021	0.11	0.062	0.021
628	Wd	73	4.9	0.33	0.05	0.027	0.011	0.05	0.027	0.011
629	Wd	25	3.0	0.16	0.00	0.000	0.000	0.00	0.000	0.000
630	Wd	21	2.8	0.22	0.00	0.000	0.000	0.00	0.000	0.000

<sup>a</sup> Sample size, number of anglers interviewed.

Appendix B2. Daily summary statistics for fishing effort, chinook salmon harvest, and chinook salmon catch by guided anglers interviewed during the early run of the fishery for chinook salmon in the downstream section of the Kenai River, 1989 (completed trip interviews only).

Date	Wd/ We	EFFORT (hrs)			HARVEST			CATCH		
		SS <sup>a</sup>	Mean	SE	Mean	SE	HPUE	Mean	SE	CPUE
517	Wd	6	2.5	0.32	0.00	0.000	0.000	0.00	0.000	0.000
518	Wd	9	4.4	0.38	0.22	0.147	0.050	0.22	0.147	0.050
519	Wd	5	4.9	0.71	0.40	0.245	0.082	0.40	0.245	0.082
520	We	21	5.8	0.29	0.10	0.066	0.016	0.10	0.066	0.016
523	Wd	10	4.8	0.39	0.20	0.133	0.041	0.20	0.133	0.041
524	Wd	11	4.9	0.42	0.27	0.141	0.056	0.27	0.141	0.056
525	Wd	5	7.2	0.73	0.00	0.000	0.000	0.00	0.000	0.000
527	We	15	4.0	0.00	0.00	0.000	0.000	0.00	0.000	0.000
528	We	14	5.4	0.54	0.14	0.097	0.026	0.14	0.097	0.026
529	We	15	4.1	0.40	0.07	0.067	0.016	0.07	0.067	0.016
530	Wd	4	6.0	1.00	0.25	0.250	0.042	0.25	0.250	0.042
602	Wd	8	3.1	0.68	0.63	0.183	0.204	0.63	0.183	0.204
603	We	61	4.0	0.22	0.44	0.064	0.109	0.51	0.069	0.126
604	We	24	4.4	0.26	0.25	0.090	0.057	0.33	0.098	0.076
606	Wd	13	7.6	1.10	0.38	0.140	0.051	0.46	0.183	0.061
607	Wd	29	4.7	0.33	0.45	0.094	0.095	0.59	0.117	0.124
608	Wd	44	4.3	0.35	0.39	0.074	0.089	0.45	0.076	0.105
609	Wd	30	4.3	0.34	0.53	0.093	0.124	0.83	0.118	0.193
610	We	22	5.7	0.33	0.14	0.075	0.024	0.14	0.075	0.024
611	We	27	5.6	0.35	0.22	0.082	0.039	0.30	0.090	0.053
613	Wd	24	4.9	0.30	0.21	0.085	0.043	0.25	0.090	0.051
614	Wd	43	4.6	0.21	0.35	0.074	0.075	0.42	0.089	0.090
615	Wd	14	5.5	0.39	0.21	0.114	0.039	0.29	0.125	0.052
616	Wd	34	5.0	0.24	0.18	0.066	0.035	0.21	0.070	0.041
617	We	45	5.5	0.08	0.07	0.038	0.012	0.13	0.051	0.024
618	We	31	5.6	0.47	0.19	0.072	0.034	0.39	0.110	0.069
620	Wd	54	4.6	0.27	0.41	0.067	0.089	0.74	0.103	0.163
621	Wd	47	4.0	0.20	0.32	0.069	0.080	0.38	0.078	0.096
622	Wd	20	4.7	0.21	0.05	0.050	0.011	0.15	0.082	0.032
623	Wd	15	4.3	0.52	0.13	0.091	0.031	0.20	0.107	0.046
624	We	54	5.3	0.33	0.22	0.057	0.042	0.33	0.070	0.062
625	We	31	4.1	0.32	0.32	0.085	0.078	0.35	0.087	0.086
627	Wd	46	4.4	0.27	0.46	0.074	0.103	0.52	0.074	0.118
628	Wd	28	8.4	0.57	0.18	0.074	0.021	0.18	0.074	0.021
629	Wd	69	5.6	0.21	0.10	0.037	0.018	0.14	0.043	0.026
630	Wd	16	5.0	0.00	0.00	0.000	0.000	0.00	0.000	0.000

<sup>a</sup> Sample size, number of anglers interviewed.

Appendix B3. Daily summary statistics for fishing effort, chinook salmon harvest, and chinook salmon catch by unguided anglers interviewed during the late run of the fishery for chinook salmon in the downstream section of the Kenai River, 1989 (completed trip interviews only).

Date	Wd/ We	EFFORT (hrs)			HARVEST			CATCH		
		SS <sup>a</sup>	Mean	SE	Mean	SE	HPUE	Mean	SE	CPUE
701	We	55	4.2	0.25	0.05	0.031	0.013	0.05	0.031	0.013
702	We	68	4.4	0.28	0.06	0.029	0.013	0.10	0.037	0.023
704	We	29	3.7	0.30	0.03	0.034	0.009	0.17	0.071	0.047
705	Wd	18	4.0	0.47	0.06	0.056	0.014	0.17	0.090	0.042
706	Wd	55	3.7	0.24	0.13	0.045	0.034	0.15	0.048	0.039
707	Wd	29	3.3	0.22	0.14	0.065	0.042	0.21	0.091	0.063
708	We	44	4.2	0.24	0.00	0.000	0.000	0.00	0.000	0.000
709	We	97	3.3	0.15	0.19	0.040	0.056	0.19	0.040	0.056
711	Wd	72	3.5	0.20	0.17	0.044	0.048	0.22	0.057	0.064
712	Wd	73	4.4	0.31	0.12	0.039	0.028	0.26	0.080	0.059
713	Wd	14	5.0	0.46	0.14	0.097	0.029	0.14	0.097	0.029
714	Wd	77	4.8	0.38	0.01	0.013	0.003	0.03	0.018	0.005
715	We	38	5.7	0.58	0.00	0.000	0.000	0.00	0.000	0.000
716	We	103	4.5	0.18	0.02	0.014	0.004	0.03	0.017	0.006
718	Wd	3	4.5	0.00	0.00	0.000	0.000	0.33	0.333	0.074
719	Wd	81	3.6	0.16	0.15	0.040	0.042	0.15	0.040	0.042
720	Wd	44	4.5	0.37	0.00	0.000	0.000	0.00	0.000	0.000
721	Wd	26	3.3	0.21	0.08	0.053	0.024	0.08	0.053	0.024
722	We	99	4.7	0.23	0.02	0.014	0.004	0.05	0.026	0.011
723	We	60	4.6	0.24	0.07	0.032	0.014	0.08	0.036	0.018
725	Wd	54	6.3	0.46	0.02	0.019	0.003	0.02	0.019	0.003
726	Wd	50	5.0	0.40	0.08	0.039	0.016	0.16	0.060	0.032
727	Wd	75	3.5	0.16	0.03	0.019	0.008	0.03	0.019	0.008
728	Wd	19	2.8	0.31	0.21	0.096	0.075	0.26	0.104	0.094
729	We	33	4.4	0.31	0.03	0.030	0.007	0.03	0.030	0.007
730	We	72	4.5	0.27	0.04	0.024	0.009	0.06	0.027	0.012

<sup>a</sup> Sample size, number of anglers interviewed.

Appendix B4. Daily summary statistics for fishing effort, chinook salmon harvest, and chinook salmon catch by guided anglers interviewed during the late run of the fishery for chinook salmon in the downstream section of the Kenai River, 1989 (completed trip interviews only).

Date	Wd/ We	EFFORT (hrs)			HARVEST			CATCH		
		SS <sup>a</sup>	Mean	SE	Mean	SE	HPUE	Mean	SE	CPUE
701	We	16	5.4	0.39	0.13	0.085	0.023	0.13	0.085	0.023
704	We	34	4.8	0.26	0.29	0.079	0.062	0.29	0.079	0.062
705	Wd	17	7.8	0.87	0.35	0.119	0.045	0.53	0.151	0.068
706	Wd	31	4.2	0.30	0.32	0.085	0.077	0.35	0.087	0.085
707	Wd	23	4.0	0.38	0.48	0.106	0.118	0.48	0.106	0.118
708	We	47	4.9	0.15	0.17	0.055	0.035	0.23	0.062	0.048
711	Wd	74	5.4	0.36	0.35	0.056	0.065	0.59	0.081	0.111
712	Wd	42	6.0	0.45	0.29	0.071	0.047	0.38	0.076	0.063
713	Wd	34	4.5	0.32	0.47	0.087	0.105	0.68	0.101	0.150
714	Wd	9	4.1	0.07	0.11	0.111	0.027	0.11	0.111	0.027
715	We	15	5.0	0.24	0.07	0.067	0.013	0.13	0.091	0.027
718	Wd	54	4.4	0.26	0.43	0.068	0.097	0.50	0.083	0.113
719	Wd	47	4.4	0.24	0.32	0.069	0.073	0.36	0.071	0.083
720	Wd	57	7.8	0.41	0.09	0.038	0.011	0.09	0.038	0.011
721	Wd	39	4.3	0.17	0.15	0.059	0.036	0.18	0.062	0.042
722	We	25	4.6	0.40	0.28	0.092	0.061	0.28	0.092	0.061
725	Wd	58	5.0	0.23	0.26	0.058	0.052	0.28	0.059	0.055
726	Wd	56	5.8	0.25	0.21	0.055	0.037	0.38	0.087	0.065
727	Wd	81	4.5	0.17	0.28	0.050	0.063	0.32	0.055	0.071
728	Wd	63	4.6	0.23	0.37	0.061	0.080	0.40	0.062	0.087
729	We	23	5.0	0.10	0.00	0.000	0.000	0.04	0.043	0.009

<sup>a</sup> Sample size, number of anglers interviewed.

Appendix B5. Daily summary statistics for fishing effort, chinook salmon harvest, and chinook salmon catch by unguided anglers interviewed during the early run of the fishery for chinook salmon in the upstream section of the Kenai River, 1989 (all interviews).

Date	Wd/ We	EFFORT (hrs)			HARVEST			CATCH		
		SS <sup>a</sup>	Mean	SE	Mean	SE	HPUE	Mean	SE	CPUE
611	We	12	3.8	0.49	0.00	0.000	0.000	0.00	0.000	0.000
613	Wd	12	2.6	0.57	0.00	0.000	0.000	0.00	0.000	0.000
614	Wd	15	2.6	0.44	0.00	0.000	0.000	0.00	0.000	0.000
616	Wd	26	2.5	0.33	0.00	0.000	0.000	0.00	0.000	0.000
617	We	74	1.7	0.13	0.00	0.000	0.000	0.00	0.000	0.000
618	We	76	2.7	0.16	0.00	0.000	0.000	0.00	0.000	0.000
620	Wd	34	2.7	0.39	0.00	0.000	0.000	0.00	0.000	0.000
621	Wd	40	1.7	0.20	0.00	0.000	0.000	0.00	0.000	0.000
622	Wd	36	1.6	0.26	0.00	0.000	0.000	0.00	0.000	0.000
624	We	80	2.0	0.16	0.01	0.013	0.006	0.01	0.013	0.006
625	We	115	2.0	0.10	0.00	0.000	0.000	0.00	0.000	0.000
628	Wd	67	2.9	0.21	0.00	0.000	0.000	0.01	0.015	0.005
629	Wd	55	2.6	0.28	0.00	0.000	0.000	0.00	0.000	0.000
630	Wd	58	2.0	0.21	0.00	0.000	0.000	0.02	0.017	0.009
701	We	153	2.4	0.14	0.00	0.000	0.000	0.00	0.000	0.000
702	We	99	1.7	0.11	0.00	0.000	0.000	0.00	0.000	0.000
705	Wd	80	1.8	0.22	0.01	0.013	0.007	0.05	0.025	0.028
706	Wd	65	2.2	0.19	0.02	0.015	0.007	0.02	0.015	0.007
707	Wd	58	2.7	0.28	0.00	0.000	0.000	0.02	0.017	0.006
708	We	102	2.2	0.16	0.02	0.014	0.009	0.03	0.017	0.013
709	We	119	2.2	0.10	0.00	0.000	0.000	0.00	0.000	0.000

<sup>a</sup> Sample size, number of anglers interviewed.

Appendix B6. Daily summary statistics for fishing effort, chinook salmon harvest, and chinook salmon catch by unguided anglers interviewed during the late run of the fishery for chinook salmon in the upstream section of the Kenai River, 1989 (all interviews).

Date	Wd/ We	EFFORT (hrs)			HARVEST			CATCH		
		SS <sup>a</sup>	Mean	SE	Mean	SE	HPUE	Mean	SE	CPUE
711	Wd	73	2.5	0.20	0.00	0.000	0.000	0.01	0.014	0.006
712	Wd	88	2.4	0.19	0.05	0.022	0.019	0.08	0.029	0.034
715	We	116	2.2	0.18	0.05	0.021	0.023	0.08	0.025	0.035
716	We	131	3.2	0.19	0.03	0.015	0.010	0.04	0.017	0.012
718	Wd	89	1.9	0.13	0.03	0.019	0.017	0.04	0.022	0.023
719	Wd	45	2.7	0.23	0.00	0.000	0.000	0.00	0.000	0.000
721	Wd	67	3.4	0.27	0.00	0.000	0.000	0.01	0.015	0.004
722	We	152	2.3	0.14	0.00	0.000	0.000	0.00	0.000	0.000
723	We	85	1.9	0.15	0.00	0.000	0.000	0.00	0.000	0.000
725	Wd	85	1.9	0.12	0.00	0.000	0.000	0.05	0.029	0.024
727	Wd	66	2.0	0.16	0.00	0.000	0.000	0.02	0.015	0.008
728	Wd	152	2.6	0.14	0.00	0.000	0.000	0.01	0.007	0.003
729	We	73	1.8	0.17	0.00	0.000	0.000	0.00	0.000	0.000
730	We	79	3.3	0.25	0.03	0.018	0.008	0.04	0.022	0.012

<sup>a</sup> Sample size, number of anglers interviewed.

Appendix B7. Daily summary statistics for fishing effort, chinook salmon harvest, and chinook salmon catch by guided anglers interviewed during the early and late runs of the fishery for chinook salmon in the upstream section of the Kenai River, 1989 (all interviews).

Date	Wd/ We	EFFORT (hrs)			HARVEST			CATCH		
		SS <sup>a</sup>	Mean	SE	Mean	SE	HPUE	Mean	SE	CPUE
<u>Early Run</u>										
613	Wd	2	5.0	0.00	0.00	0.000	0.000	0.00	0.000	0.000
614	Wd	5	6.0	0.00	0.00	0.000	0.000	0.00	0.000	0.000
617	We	9	3.7	0.37	0.11	0.111	0.030	0.11	0.111	0.030
618	We	3	6.5	0.00	0.00	0.000	0.000	0.00	0.000	0.000
620	Wd	5	4.8	1.32	0.20	0.200	0.042	0.20	0.200	0.042
622	Wd	8	2.1	0.08	0.13	0.125	0.059	0.25	0.164	0.118
624	We	3	2.8	0.60	0.67	0.333	0.235	2.00	0.577	0.706
628	Wd	5	1.4	0.24	0.00	0.000	0.000	0.00	0.000	0.000
629	Wd	5	3.9	0.86	0.20	0.200	0.051	0.40	0.245	0.103
630	Wd	7	2.9	0.34	0.14	0.143	0.050	0.57	0.369	0.200
701	We	10	4.0	0.64	0.40	0.163	0.099	0.40	0.163	0.099
705	Wd	3	1.0	0.00	0.33	0.333	0.333	0.33	0.333	0.333
706	Wd	8	3.1	0.32	0.13	0.125	0.041	0.25	0.164	0.082
<u>Late Run</u>										
711	Wd	2	2.0	0.00	0.00	0.000	0.000	0.00	0.000	0.000
712	Wd	8	3.3	0.66	0.00	0.000	0.000	0.00	0.000	0.000
715	We	9	2.3	0.19	0.22	0.147	0.095	0.22	0.147	0.095
718	Wd	7	4.2	0.78	0.43	0.202	0.102	1.29	0.474	0.305
719	Wd	5	4.2	0.30	0.20	0.200	0.048	0.20	0.200	0.048
721	Wd	7	2.9	0.52	0.29	0.184	0.100	0.29	0.184	0.100
722	We	19	3.6	0.34	0.16	0.086	0.044	0.16	0.086	0.044
725	Wd	5	2.9	0.37	0.20	0.200	0.069	0.60	0.400	0.207
728	Wd	4	6.0	0.00	0.00	0.000	0.000	0.00	0.000	0.000
729	We	2	3.5	0.00	0.00	0.000	0.000	0.00	0.000	0.000

<sup>a</sup> Sample size, number of anglers interviewed.

APPENDIX C

Counts of anglers during the creel survey of the fishery for coho salmon in the Kenai River, 1989

Appendix C1. Counts of unguided and guided boat anglers during the fishery for coho salmon in August and September in the downstream section of the Kenai River, 1989.

Date	Wd/ We	Unguided Anglers Period				Guided Anglers Period			
		A	B	C	D	A	B	C	D
8/01	Wd								
8/02	Wd	15		37		69		25	
8/03	Wd		29	56			43	27	
8/04	Wd	49		77		95		19	
8/05	We		203		144		108		9
8/06	We	221		101		111		35	
8/07	Wd			84	110			58	20
8/08	Wd	170	191			197	183		
8/09	Wd	71		86		151		78	
8/10	Wd								
8/11	Wd								
8/12	We		476	506			211	105	
8/13	We	349			174	200			24
8/14	Wd		161	150			87	38	
8/15	Wd	182	149			168	81		
8/16	Wd								
8/17	Wd								
8/18	Wd			188	168			50	16
8/19	We	302			120	138			13
8/20	We		349	250			153	71	
8/21	Wd		148	116			51	16	
8/22	Wd								
8/23	Wd								
8/24	Wd			127	93			52	25
8/25	Wd	112	161			136	133		
8/26	We	253				135			
8/27	We			58	5			20	4
8/28	Wd	49	58			81	50		
8/29	Wd	38				71			
8/30	Wd								
8/31	Wd								
9/01	Wd								
9/02	We								
9/03	We								
9/04	We		126	70			70	13	
9/05	Wd		59	44			42	14	
9/06	Wd								
9/07	Wd								
9/08	Wd								
9/09	-We	232		182		153		38	

-Continued-

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Date	Wd/ We	Unguided Anglers Period				Guided Anglers Period			
		A	B	C	D	A	B	C	D
9/10	We		172				59		
9/11	Wd								
9/12	Wd		62	70			39	22	
9/13	Wd	59		84		144		26	
9/14	Wd								
9/15	Wd								
9/16	We		265	220			135	53	
9/17	We	184	140			82	65		
9/18	Wd	82		56		55		21	
9/19	Wd		52	23			15	9	
9/20	Wd								
9/21	Wd								
9/22	Wd	106	47			38	29		
9/23	We		205	116			34	9	
9/24	We	225		49		71		0	
9/25	Wd								
9/26	Wd	56	48			35	21		
9/27	Wd	53		16		51		25	

Appendix C2. Counts of shore anglers during the fishery for coho salmon in August and September in the downstream section of the Kenai River, 1989.

Date	Wd/ We	Period			
		A	B	C	D
8/01	Wd				
8/02	Wd	21	33		
8/03	Wd		67	69	
8/04	Wd	44		56	
8/05	We		69		74
8/06	We	64		121	
8/07	Wd			96	72
8/08	Wd	101	99		
8/09	Wd	35		87	
8/10	Wd				
8/11	Wd				
8/12	We	117		206	
8/13	We	105			101
8/14	Wd	97		80	
8/15	Wd	107	88		
8/16	Wd				
8/17	Wd				
8/18	Wd			88	32
8/19	We	63			32
8/20	We		102	121	
8/21	Wd		82	99	
8/22	Wd				
8/23	Wd				
8/24	Wd		36		59
8/25	Wd	43	42		
8/26	We	51			
8/27	We			21	11
8/28	Wd	34	36		
8/29	Wd	23			
8/30	Wd				
8/31	Wd				
9/01	Wd				
9/02	We				
9/03	We				
9/04	We		41	23	
9/05	Wd		11	8	
9/06	Wd				
9/07	Wd				
9/08	Wd				
9/09	We	55		51	

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Date	Wd/ We	Period			
		A	B	C	D
9/10	We		54		
9/11	Wd				
9/12	Wd		21	37	
9/13	Wd	52		32	
9/14	Wd				
9/15	Wd				
9/16	We		49	52	
9/17	We	39	52		
9/18	Wd	35		34	
9/19	Wd		31	19	
9/20	Wd				
9/21	Wd				
9/22	Wd	44	40		
9/23	We		72	61	
9/24	We	71		26	
9/25	Wd				
9/26	Wd	38	28		
9/27	Wd	25		23	

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Appendix C3. Counts of unguided and guided anglers during the fishery for coho salmon in August and September in the upstream section of the Kenai River, 1989.

Date	Wd/ We	Unguided Anglers Period				Guided Anglers Period			
		A	B	C	D	A	B	C	D
8/01	Wd								
8/02	Wd	42	111			0	13		
8/03	Wd		75	69			11	3	
8/04	Wd	53	68			5	16		
8/05	We		223		105		11		5
8/06	We	83		109		3		3	
8/07	Wd								
8/08	Wd								
8/09	Wd	0		16		0		0	
8/10	Wd			26	6			13	0
8/11	Wd	20	22			12	5		
8/12	We		65	73			10	0	
8/13	We	19			40	0			0
8/14	Wd		17	23			11	9	
8/15	Wd	14		24		4		4	
8/16	Wd								
8/17	Wd			47	53			22	16
8/18	Wd			51	41			13	8
8/19	We								
8/20	We		120	70			6	0	
8/21	Wd		57	47			12	4	
8/22	Wd								
8/23	Wd								
8/24	Wd			22	21			5	0
8/25	Wd	0	8			0	3		
8/26	We	14	57			3	13		
8/27	We			63	33			7	0
8/28	Wd	7	24			0	10		
8/29	Wd	2			15	0			0
8/30	Wd								
8/31	Wd								
9/01	Wd		6	4			3	0	
9/02	We		65	50			14	0	
9/03	We	86	78			23	13		
9/04	We	38	69			8	8		
9/05	Wd		24	14			7	0	
9/06	Wd	17	18			3	0		
9/07	Wd								
9/08	Wd								
9/09	We	21		53		0		0	

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Date	Wd/ We	Unguided Anglers Period				Guided Anglers Period			
		A	B	C	D	A	B	C	D
9/10	We								
9/11	Wd	6	16			0	6		
9/12	Wd		32	23			3	0	
9/13	Wd								
9/14	Wd								
9/15	Wd	32		25		0		4	
9/16	We	30	89			5	0		
9/17	We		55	31			2	0	
9/18	Wd	31		31		0		0	
9/19	Wd		25	34			7	0	
9/20	Wd								
9/21	Wd								
9/22	Wd	58	53			9	3		
9/23	We		70	47			0	0	
9/24	We	54		36		0		0	
9/25	Wd	29	34			4	0		
9/26	Wd		27	24			3	0	
9/27	Wd								
9/28	Wd								
9/29	Wd	52				7			



APPENDIX D

Daily summary statistics for fishing effort, harvest rate,  
and catch rate for anglers interviewed during the fishery  
for coho salmon in the Kenai River, 1989

Appendix D1. Daily summary statistics for fishing effort, coho salmon harvest, and coho salmon catch by unguided boat anglers interviewed during the fishery for coho salmon in August and September in the downstream section of the Kenai River, 1989 (both completed trip and incompleted trip interviews).

Date	Wd/ We	EFFORT (hrs)			HARVEST			CATCH		
		SS <sup>a</sup>	Mean	SE	Mean	SE	HPUE	Mean	SE	CPUE
802	Wd	6	2.0	0.00	0.17	0.167	0.083	0.17	0.167	0.083
803	Wd	10	1.8	0.50	0.10	0.100	0.057	0.10	0.100	0.057
804	Wd	16	2.8	0.42	0.06	0.063	0.023	0.06	0.063	0.023
805	We	23	4.1	0.64	0.43	0.176	0.105	0.43	0.176	0.105
806	We	26	1.9	0.22	0.73	0.171	0.388	0.73	0.171	0.388
807	Wd	23	3.2	0.44	0.65	0.173	0.203	0.65	0.173	0.203
808	Wd	14	3.3	0.37	0.50	0.251	0.152	0.50	0.251	0.152
809	Wd	27	1.8	0.18	0.22	0.097	0.125	0.22	0.097	0.125
812	We	53	3.8	0.30	0.28	0.099	0.074	0.28	0.099	0.074
813	We	38	2.2	0.17	0.68	0.151	0.311	0.68	0.151	0.311
814	Wd	24	2.5	0.18	0.42	0.158	0.169	0.42	0.158	0.169
815	Wd	30	2.7	0.28	0.40	0.156	0.149	0.40	0.156	0.149
818	Wd	44	3.5	0.42	0.20	0.070	0.058	0.20	0.070	0.058
819	We	34	2.7	0.22	0.26	0.114	0.099	0.26	0.114	0.099
820	We	45	2.8	0.49	0.51	0.148	0.180	0.53	0.151	0.188
821	Wd	15	2.7	0.23	0.67	0.252	0.250	0.67	0.252	0.250
824	Wd	21	3.5	0.42	0.38	0.161	0.110	0.38	0.161	0.110
825	Wd	9	2.6	0.18	0.44	0.338	0.174	0.67	0.553	0.261
826	We	67	2.2	0.15	0.48	0.091	0.216	0.48	0.091	0.216
827	We	19	3.4	0.38	0.63	0.219	0.188	0.63	0.219	0.188
828	Wd	7	3.0	0.38	2.14	0.459	0.714	2.14	0.459	0.714
829	Wd	5	2.0	0.00	0.60	0.400	0.300	0.60	0.400	0.300
904	We	21	3.6	0.56	0.48	0.190	0.133	0.48	0.190	0.133
905	Wd	17	5.5	0.38	1.00	0.297	0.181	1.00	0.297	0.181
909	We	48	3.2	0.33	0.56	0.143	0.176	0.56	0.143	0.176
910	We	27	7.2	0.41	0.48	0.163	0.067	0.48	0.163	0.067
912	Wd	15	3.4	0.53	0.93	0.284	0.272	0.93	0.284	0.272
913	Wd	23	2.9	0.26	0.61	0.206	0.211	0.61	0.206	0.211
916	We	44	3.0	0.32	0.48	0.119	0.158	0.52	0.140	0.174
917	We	42	3.5	0.35	0.48	0.149	0.136	0.48	0.149	0.136
918	Wd	28	3.9	0.49	0.43	0.140	0.109	0.46	0.158	0.118
919	Wd	25	2.2	0.19	0.64	0.181	0.288	0.64	0.181	0.288
922	Wd	42	2.9	0.37	1.05	0.167	0.365	1.05	0.167	0.365
923	We	49	2.9	0.24	0.61	0.145	0.214	0.63	0.145	0.221
924	We	63	2.8	0.21	0.46	0.115	0.162	0.51	0.136	0.178
926	Wd	32	3.9	0.34	0.56	0.185	0.146	0.56	0.185	0.146
927	Wd	34	2.4	0.23	0.91	0.217	0.380	0.91	0.217	0.380

<sup>a</sup> Sample size, number of anglers interviewed.

Appendix D2. Daily summary statistics for fishing effort, coho salmon harvest, and coho salmon catch by guided boat anglers interviewed during the fishery for coho salmon in August and September in the downstream section of the Kenai River, 1989 (both completed trip and incompletd trip interviews).

Date	Wd/ We	EFFORT (hrs)			HARVEST			CATCH		
		SS <sup>a</sup>	Mean	SE	Mean	SE	HPUE	Mean	SE	CPUE
802	Wd	28	3.4	0.41	0.18	0.104	0.052	0.18	0.104	0.052
803	Wd	6	6.0	1.00	0.17	0.167	0.028	0.17	0.167	0.028
804	Wd	18	3.7	0.57	0.56	0.202	0.152	0.56	0.202	0.152
805	We	22	5.7	0.39	0.68	0.202	0.120	0.68	0.202	0.120
806	We	28	5.7	0.42	1.11	0.214	0.195	1.11	0.214	0.195
807	Wd	21	2.5	0.25	1.00	0.218	0.396	1.00	0.218	0.396
808	Wd	20	4.5	0.23	1.00	0.262	0.220	1.00	0.262	0.220
809	Wd	30	2.0	0.14	0.97	0.222	0.487	0.97	0.222	0.487
812	We	21	6.3	0.13	1.00	0.301	0.158	1.00	0.301	0.158
813	We	24	3.1	0.19	0.88	0.243	0.280	0.88	0.243	0.280
814	Wd	36	5.2	0.50	1.83	0.220	0.355	1.83	0.220	0.355
815	Wd	39	5.0	0.26	0.69	0.191	0.138	0.69	0.191	0.138
818	Wd	4	7.0	0.00	0.50	0.500	0.071	0.50	0.500	0.071
819	We	35	4.5	0.24	1.06	0.239	0.234	1.06	0.239	0.234
820	We	9	3.2	0.88	0.78	0.434	0.241	0.78	0.434	0.241
821	Wd	13	3.2	0.75	0.54	0.268	0.169	0.54	0.268	0.169
824	Wd	15	4.1	0.55	0.73	0.284	0.177	0.73	0.284	0.177
825	Wd	36	2.3	0.19	1.00	0.207	0.434	1.00	0.207	0.434
826	We	39	3.8	0.17	0.67	0.153	0.176	0.67	0.153	0.176
827	We	4	5.0	0.00	1.50	0.866	0.300	1.50	0.866	0.300
828	Wd	29	3.6	0.16	0.93	0.216	0.256	0.93	0.216	0.256
829	Wd	38	2.8	0.21	0.39	0.116	0.140	0.39	0.116	0.140
904	We	15	7.7	0.50	1.73	0.371	0.226	1.73	0.371	0.226
905	Wd	20	3.8	0.43	1.25	0.307	0.333	1.25	0.307	0.333
909	We	31	3.5	0.17	1.10	0.247	0.313	1.10	0.247	0.313
910	We	9	5.0	0.76	0.33	0.333	0.067	0.33	0.333	0.067
912	Wd	17	5.0	0.68	1.53	0.333	0.308	1.53	0.333	0.308
913	Wd	42	4.3	0.20	1.62	0.215	0.380	1.62	0.215	0.380
916	We	11	5.7	0.56	1.55	0.340	0.270	1.55	0.340	0.270
917	We	30	4.2	0.51	0.93	0.235	0.225	0.93	0.235	0.225
918	Wd	15	6.1	0.52	0.87	0.274	0.141	0.87	0.274	0.141
919	Wd	12	3.3	0.38	0.83	0.386	0.250	0.83	0.386	0.250
922	Wd	24	3.6	0.07	0.96	0.204	0.269	0.96	0.204	0.269
923	We	10	5.3	0.75	1.70	0.473	0.324	1.70	0.473	0.324
924	We	9	3.0	0.00	0.44	0.338	0.148	0.44	0.338	0.148
926	Wd	19	3.1	0.60	0.84	0.308	0.274	0.84	0.308	0.274
927	Wd	17	2.8	0.10	1.06	0.337	0.375	1.06	0.337	0.375

<sup>a</sup> Sample size, number of anglers interviewed.

Appendix D3. Daily summary statistics for fishing effort, coho salmon harvest, and coho salmon catch by shore anglers interviewed during the fishery for coho salmon in August and September in the downstream section of the Kenai River, 1989 (both completed trip and incompletd trip interviews).

Date	Wd/ We	EFFORT (hrs)			HARVEST			CATCH		
		SS <sup>a</sup>	Mean	SE	Mean	SE	HPUE	Mean	SE	CPUE
802	Wd	2	1.5	0.50	0.50	0.500	0.333	0.50	0.500	0.333
807	Wd	2	3.0	0.00	0.00	0.000	0.000	0.00	0.000	0.000
814	Wd	8	2.1	0.44	0.25	0.164	0.118	0.25	0.164	0.118
815	Wd	2	4.0	0.00	0.00	0.000	0.000	0.00	0.000	0.000
818	Wd	2	2.5	0.50	0.00	0.000	0.000	0.00	0.000	0.000
819	We	2	2.5	1.50	0.00	0.000	0.000	0.00	0.000	0.000
820	We	8	2.7	0.77	0.13	0.125	0.047	0.13	0.125	0.047
821	Wd	4	2.3	0.63	0.50	0.289	0.222	0.50	0.289	0.222
824	Wd	4	3.5	0.87	0.75	0.479	0.214	0.75	0.479	0.214
825	Wd	3	2.3	0.17	1.33	0.667	0.571	1.33	0.667	0.571
827	We	5	4.9	1.19	0.60	0.400	0.122	0.60	0.400	0.122
828	Wd	4	2.5	0.29	0.75	0.250	0.300	0.75	0.250	0.300
829	Wd	4	0.8	0.14	0.25	0.250	0.333	0.25	0.250	0.333
909	We	5	2.4	0.40	0.60	0.400	0.250	0.60	0.400	0.250
910	We	7	4.4	1.46	0.29	0.184	0.065	0.29	0.184	0.065
912	Wd	3	5.0	0.00	0.33	0.333	0.067	0.33	0.333	0.067
913	Wd	7	2.4	0.20	0.86	0.404	0.353	0.86	0.404	0.353
916	We	3	3.3	0.17	0.33	0.333	0.100	0.33	0.333	0.100
917	We	4	1.3	0.25	0.00	0.000	0.000	0.00	0.000	0.000
918	Wd	8	4.3	1.09	0.63	0.324	0.147	0.63	0.324	0.147
922	Wd	5	1.3	0.30	0.20	0.200	0.154	0.20	0.200	0.154
923	We	10	2.5	0.76	0.30	0.213	0.122	0.30	0.213	0.122
924	We	10	5.7	0.92	0.60	0.221	0.105	0.60	0.221	0.105
926	Wd	3	2.0	1.00	0.00	0.000	0.000	0.00	0.000	0.000

<sup>a</sup> Sample size, number of anglers interviewed.

Appendix D4. Daily summary statistics for fishing effort, coho salmon harvest, and coho salmon catch by unguided boat anglers interviewed during the fishery for coho salmon in August and September in the upstream section of the Kenai River, 1989 (both completed trip and incompletd trip interviews).

Date	Wd/ We	EFFORT (hrs)			HARVEST			CATCH		
		SS <sup>a</sup>	Mean	SE	Mean	SE	HPUE	Mean	SE	CPUE
802	Wd	46	2.6	0.30	0.00	0.000	0.000	0.00	0.000	0.000
803	Wd	59	1.9	0.17	0.02	0.017	0.009	0.02	0.017	0.009
804	Wd	34	1.4	0.12	0.00	0.000	0.000	0.00	0.000	0.000
805	We	115	2.1	0.20	0.02	0.012	0.008	0.02	0.012	0.008
806	We	113	2.5	0.17	0.01	0.009	0.003	0.01	0.009	0.003
809	Wd	20	1.9	0.32	0.05	0.050	0.026	0.05	0.050	0.026
810	Wd	24	3.0	0.42	0.13	0.092	0.041	0.13	0.092	0.041
811	Wd	31	1.9	0.20	0.26	0.080	0.137	0.26	0.080	0.137
812	We	103	2.0	0.12	0.15	0.038	0.074	0.15	0.038	0.074
813	We	63	2.2	0.19	0.41	0.103	0.192	0.41	0.103	0.192
814	Wd	45	2.1	0.17	0.29	0.093	0.141	0.29	0.093	0.141
815	Wd	34	1.5	0.24	0.38	0.134	0.263	0.38	0.134	0.263
817	Wd	38	2.4	0.22	0.18	0.064	0.076	0.18	0.064	0.076
818	Wd	33	3.2	0.32	0.45	0.131	0.142	0.45	0.131	0.142
820	We	143	2.4	0.13	0.34	0.054	0.143	0.34	0.054	0.143
821	Wd	89	2.2	0.13	0.17	0.046	0.075	0.17	0.046	0.075
824	Wd	50	1.8	0.14	0.06	0.034	0.033	0.10	0.052	0.054
825	Wd	13	1.5	0.24	0.00	0.000	0.000	0.00	0.000	0.000
826	We	36	1.9	0.23	0.25	0.101	0.129	0.25	0.101	0.129
827	We	84	2.5	0.19	0.21	0.059	0.086	0.25	0.074	0.100
828	Wd	30	1.4	0.14	0.33	0.138	0.238	0.37	0.148	0.262
829	Wd	22	2.3	0.33	0.23	0.113	0.099	0.23	0.113	0.099
901	Wd	13	2.8	0.41	0.62	0.311	0.222	0.77	0.323	0.278
902	We	97	2.3	0.17	0.22	0.055	0.095	0.28	0.085	0.122
903	We	132	1.9	0.10	0.26	0.046	0.138	0.30	0.051	0.159
904	We	91	1.8	0.11	0.20	0.042	0.109	0.25	0.048	0.140
905	Wd	37	1.7	0.16	0.16	0.061	0.097	0.16	0.061	0.097
906	Wd	28	1.5	0.19	0.32	0.104	0.212	0.32	0.104	0.212
909	We	74	2.1	0.15	0.36	0.076	0.177	0.39	0.088	0.190
910	We	78	2.2	0.17	0.22	0.054	0.098	0.23	0.055	0.103
911	Wd	27	2.2	0.29	0.41	0.134	0.183	0.41	0.134	0.183
912	Wd	58	2.4	0.18	0.34	0.080	0.142	0.36	0.080	0.149
915	Wd	63	1.9	0.18	0.73	0.114	0.388	0.73	0.114	0.388
916	We	136	2.0	0.10	0.26	0.045	0.127	0.26	0.045	0.127
917	We	65	2.8	0.19	0.45	0.082	0.162	0.46	0.088	0.168
918	Wd	61	2.2	0.19	0.62	0.102	0.289	0.62	0.102	0.289
919	Wd	54	2.1	0.15	0.35	0.088	0.170	0.35	0.088	0.170

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Appendix D4. (Page 2 of 2).

Date	Wd/ We	EFFORT (hrs)			HARVEST			CATCH		
		SS <sup>a</sup>	Mean	SE	Mean	SE	HPUE	Mean	SE	CPUE
922	Wd	78	1.7	0.11	0.41	0.074	0.246	0.41	0.074	0.246
923	We	94	3.2	0.17	0.32	0.061	0.099	0.32	0.061	0.099
924	We	77	2.3	0.22	0.49	0.080	0.213	0.49	0.080	0.213
925	Wd	71	1.8	0.14	0.42	0.071	0.233	0.44	0.074	0.240
926	Wd	46	2.0	0.18	0.30	0.075	0.153	0.33	0.076	0.164

<sup>a</sup> Sample size, number of anglers interviewed.

Appendix D5. Daily summary statistics for fishing effort, coho salmon harvest, and coho salmon catch by guided boat anglers interviewed during the fishery for coho salmon in August and September in the upstream section of the Kenai River, 1989 (both completed trip and incompletd trip interviews).

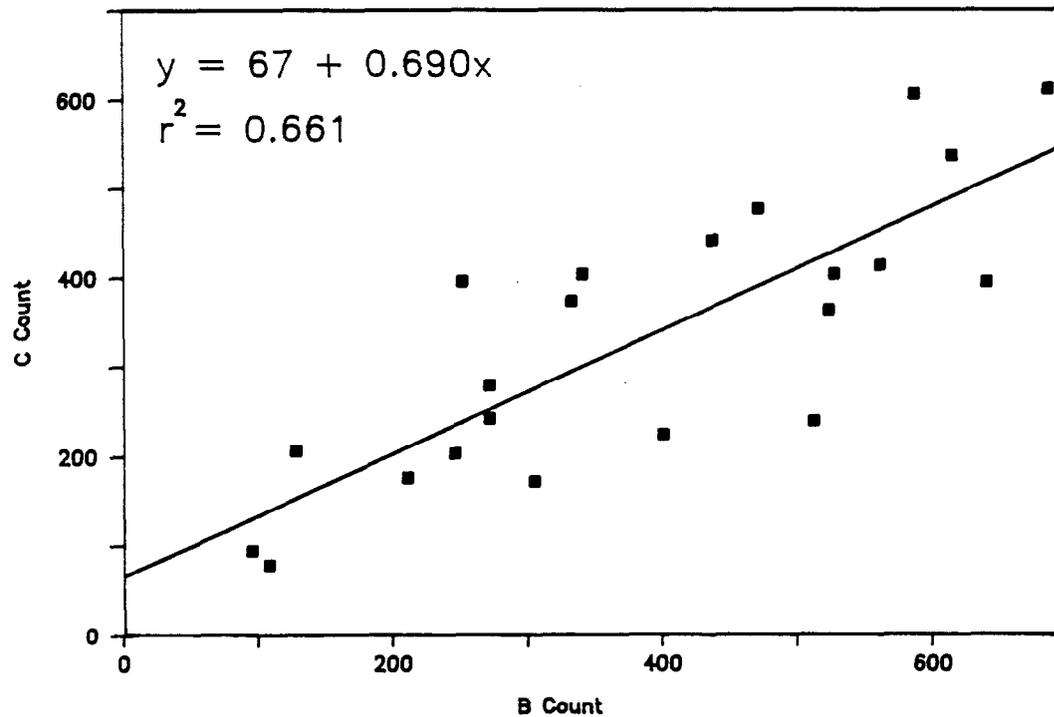
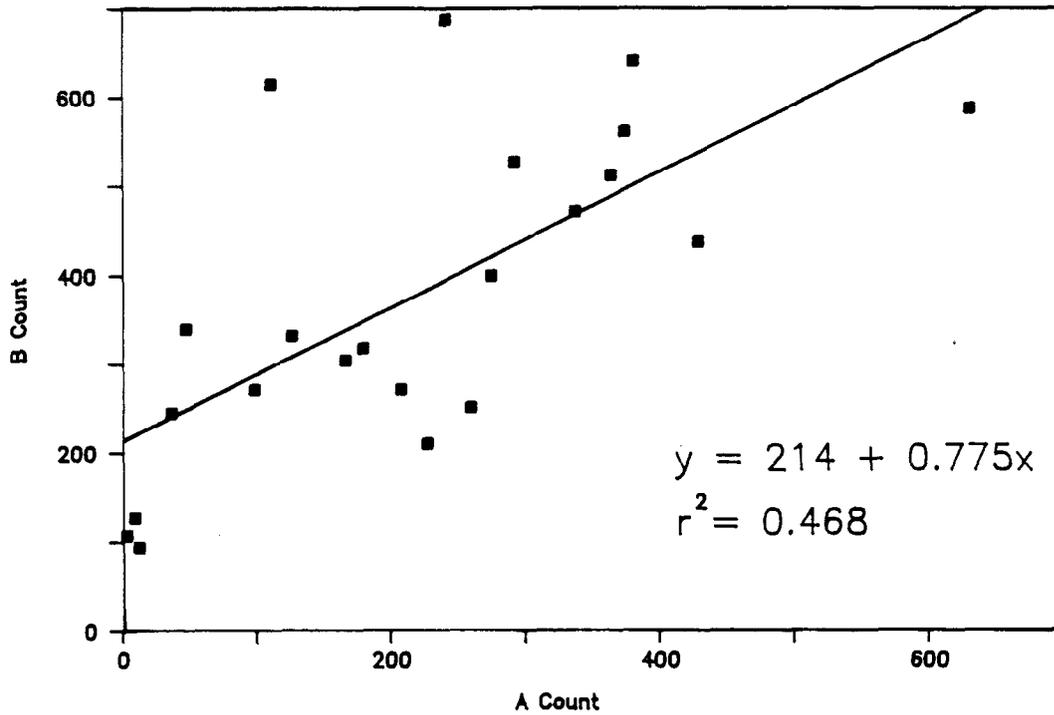
Date	Wd/ We	EFFORT (hrs)			HARVEST			CATCH		
		SS <sup>a</sup>	Mean	SE	Mean	SE	HPUE	Mean	SE	CPUE
802	Wd	13	2.8	0.42	0.00	0.000	0.000	0.00	0.000	0.000
803	Wd	11	3.0	0.00	0.00	0.000	0.000	0.00	0.000	0.000
804	Wd	20	1.3	0.15	0.00	0.000	0.000	0.00	0.000	0.000
805	We	17	2.5	0.30	0.00	0.000	0.000	0.00	0.000	0.000
806	We	8	1.8	0.41	0.00	0.000	0.000	0.00	0.000	0.000
810	Wd	13	3.9	0.55	0.46	0.183	0.118	0.46	0.183	0.118
811	Wd	15	2.0	0.27	0.73	0.284	0.367	0.87	0.291	0.433
812	We	8	2.0	0.00	0.13	0.125	0.063	0.13	0.125	0.063
814	Wd	12	4.0	0.00	2.50	0.230	0.625	2.50	0.230	0.625
815	Wd	8	2.0	0.38	0.63	0.263	0.313	0.63	0.263	0.313
817	Wd	19	2.8	0.20	0.79	0.237	0.280	0.79	0.237	0.280
818	Wd	4	8.0	0.00	1.75	0.750	0.219	1.75	0.750	0.219
820	We	6	3.8	0.11	1.33	0.333	0.356	1.33	0.333	0.356
821	Wd	13	4.1	0.40	0.85	0.274	0.208	0.85	0.274	0.208
824	Wd	4	1.0	0.00	0.00	0.000	0.000	0.00	0.000	0.000
825	Wd	3	3.0	0.00	0.33	0.333	0.111	0.33	0.333	0.111
826	We	13	4.2	0.45	0.77	0.201	0.183	0.77	0.201	0.183
827	We	6	4.0	0.63	0.33	0.333	0.083	0.33	0.333	0.083
828	Wd	10	3.9	0.08	0.90	0.233	0.234	0.90	0.233	0.234
829	Wd	4	2.0	0.00	0.50	0.289	0.250	0.50	0.289	0.250
901	Wd	3	2.0	0.00	2.33	0.333	1.167	3.67	0.882	1.833
902	We	15	5.6	0.27	0.13	0.091	0.024	0.13	0.091	0.024
903	We	25	2.3	0.22	0.36	0.114	0.158	0.36	0.114	0.158
904	We	16	2.8	0.25	0.69	0.198	0.250	0.69	0.198	0.250
905	Wd	7	2.9	0.91	0.43	0.297	0.146	0.43	0.297	0.146
906	Wd	3	3.0	0.00	1.33	0.333	0.444	1.33	0.333	0.444
910	We	10	4.0	0.39	1.00	0.394	0.250	1.00	0.394	0.250
911	Wd	6	4.0	0.22	0.17	0.167	0.042	0.17	0.167	0.042
912	Wd	6	1.8	0.56	1.17	0.401	0.667	1.17	0.401	0.667
915	Wd	11	2.8	0.76	1.27	0.384	0.452	1.27	0.384	0.452
916	We	5	4.5	0.00	0.40	0.245	0.089	0.40	0.245	0.089
917	We	2	1.5	0.00	0.00	0.000	0.000	0.00	0.000	0.000
919	Wd	7	4.8	0.10	2.29	0.286	0.478	2.57	0.369	0.537
922	Wd	9	2.2	0.15	1.22	0.364	0.550	1.22	0.364	0.550
925	Wd	4	1.5	0.00	1.75	0.250	1.167	1.75	0.250	1.167
926	Wd	3	1.5	0.00	0.67	0.333	0.444	0.67	0.333	0.444

<sup>a</sup> Sample size, number of anglers interviewed.

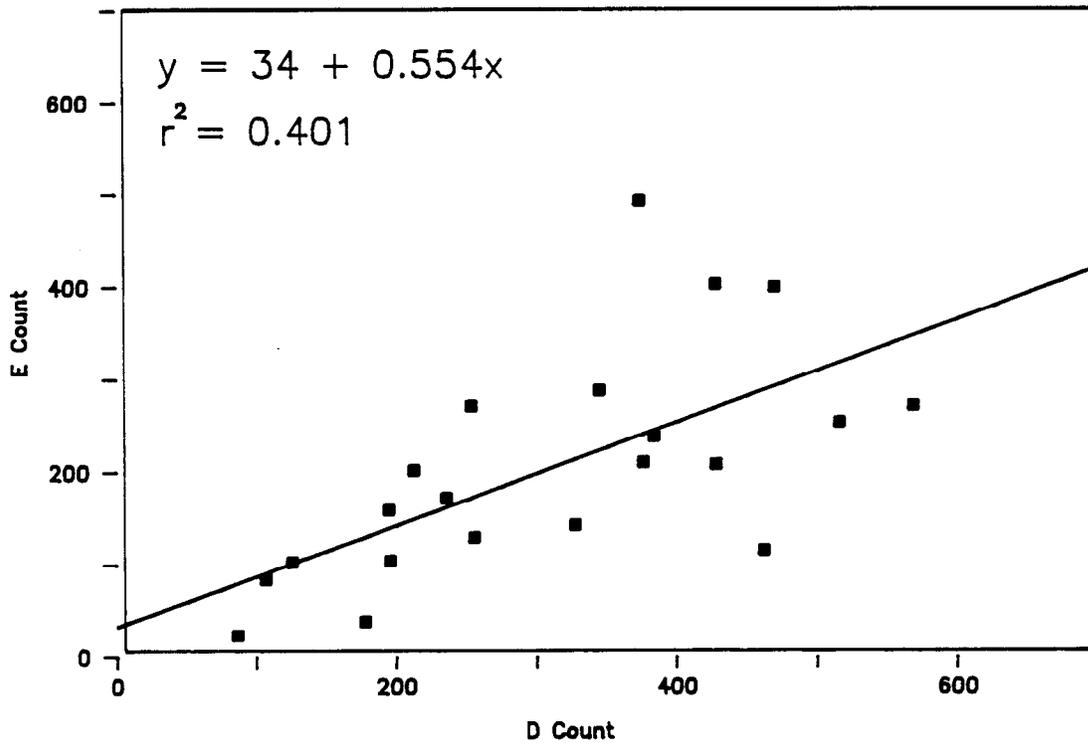
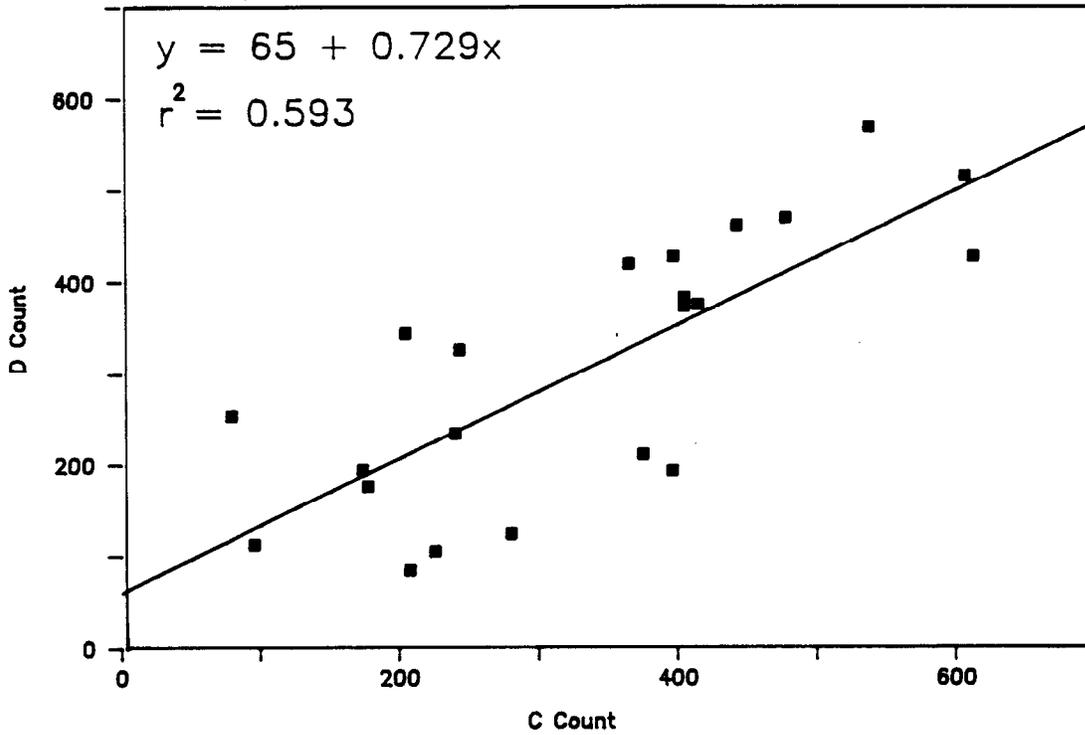


APPENDIX E

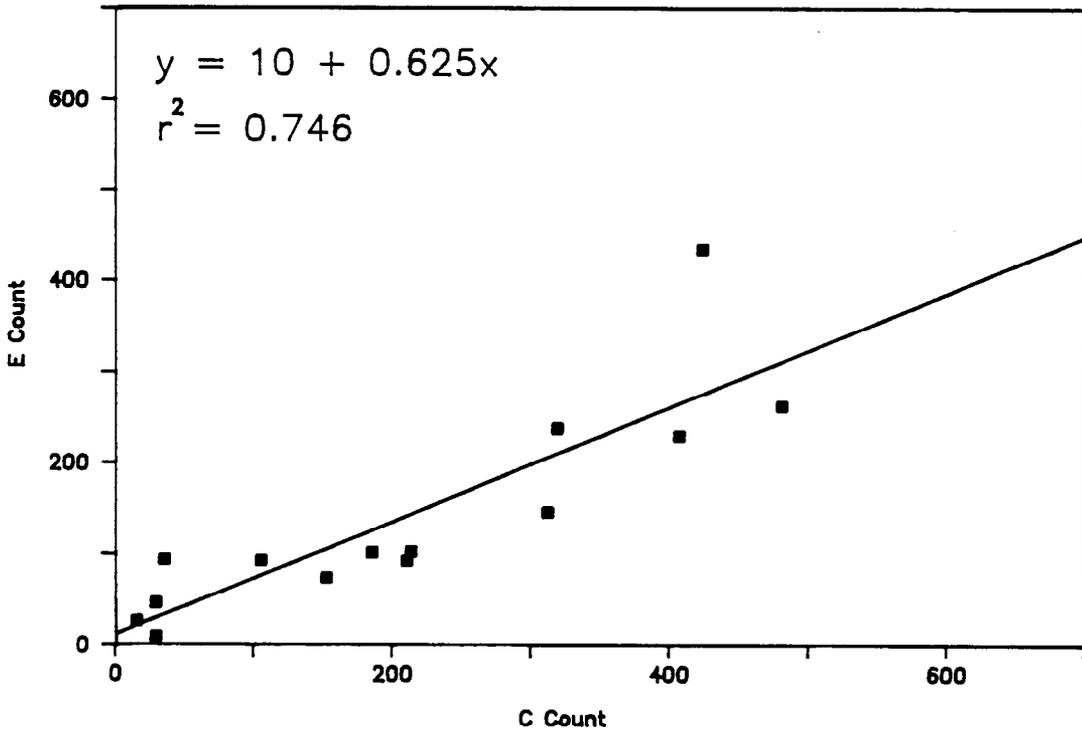
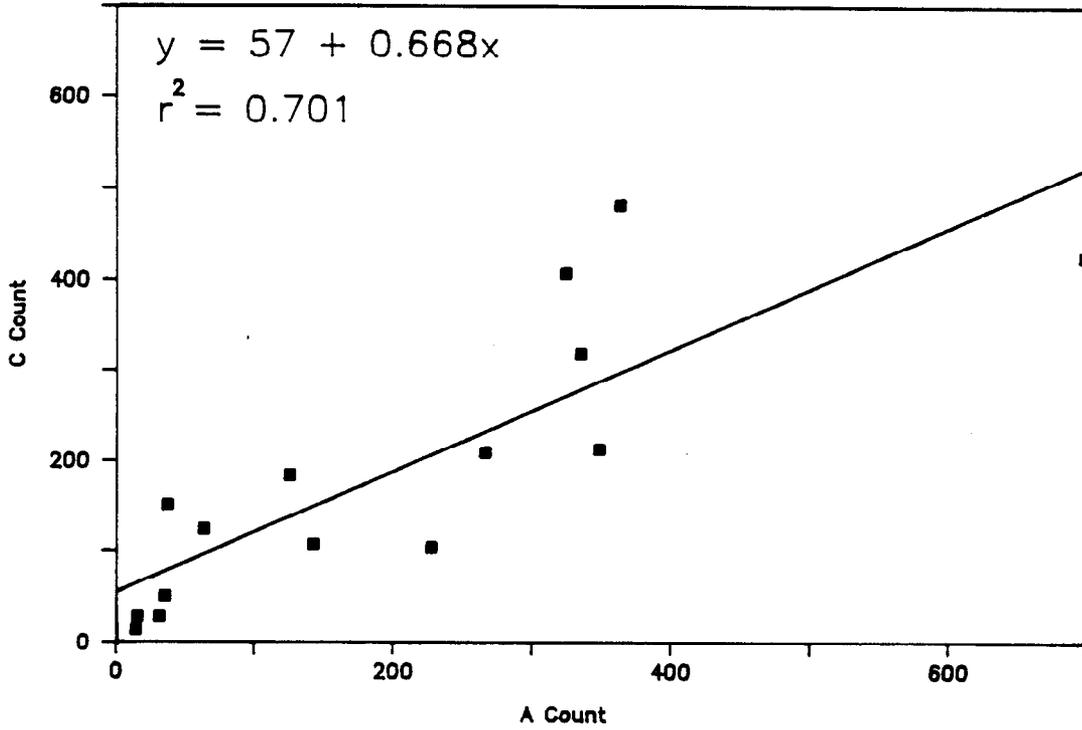
Regression analysis of boat angler counts during the creel survey  
of the fishery for chinook salmon in the Kenai River, 1989.



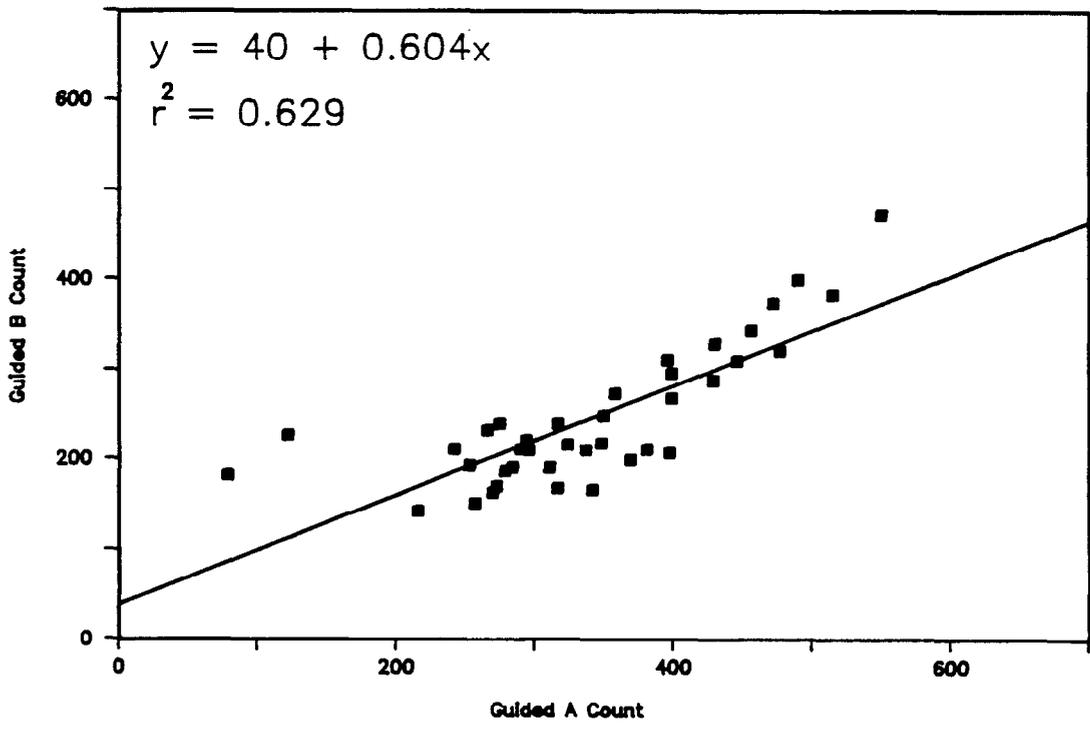
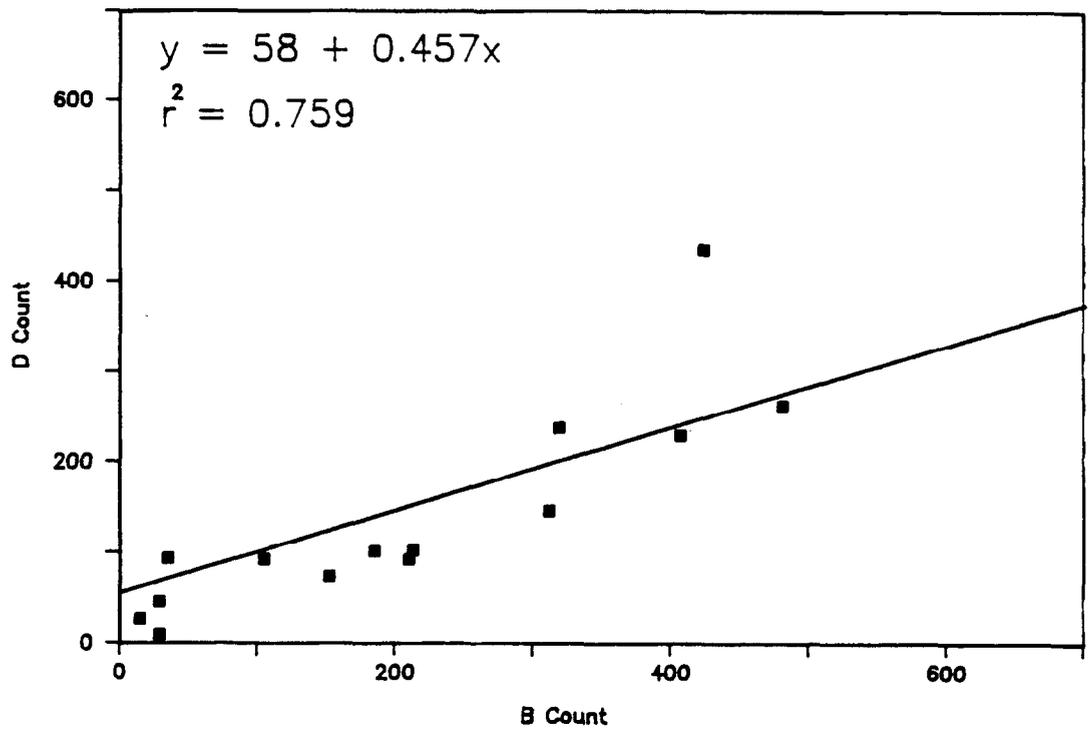
Appendix E1. Regression analysis of consecutive period unguided angler counts in the Kenai River chinook salmon fishery, weekend/holiday only (A vs B, B vs C), 1989.



Appendix E2. Regression analysis of consecutive period unguided angler counts in the Kenai River chinook salmon fishery, weekend/holiday only (C vs D, D vs E), 1989.



Appendix E3. Regression analysis of consecutive unguided angler counts in the Kenai River chinook salmon fishery, weekday periods (A vs C, C vs E), 1989.



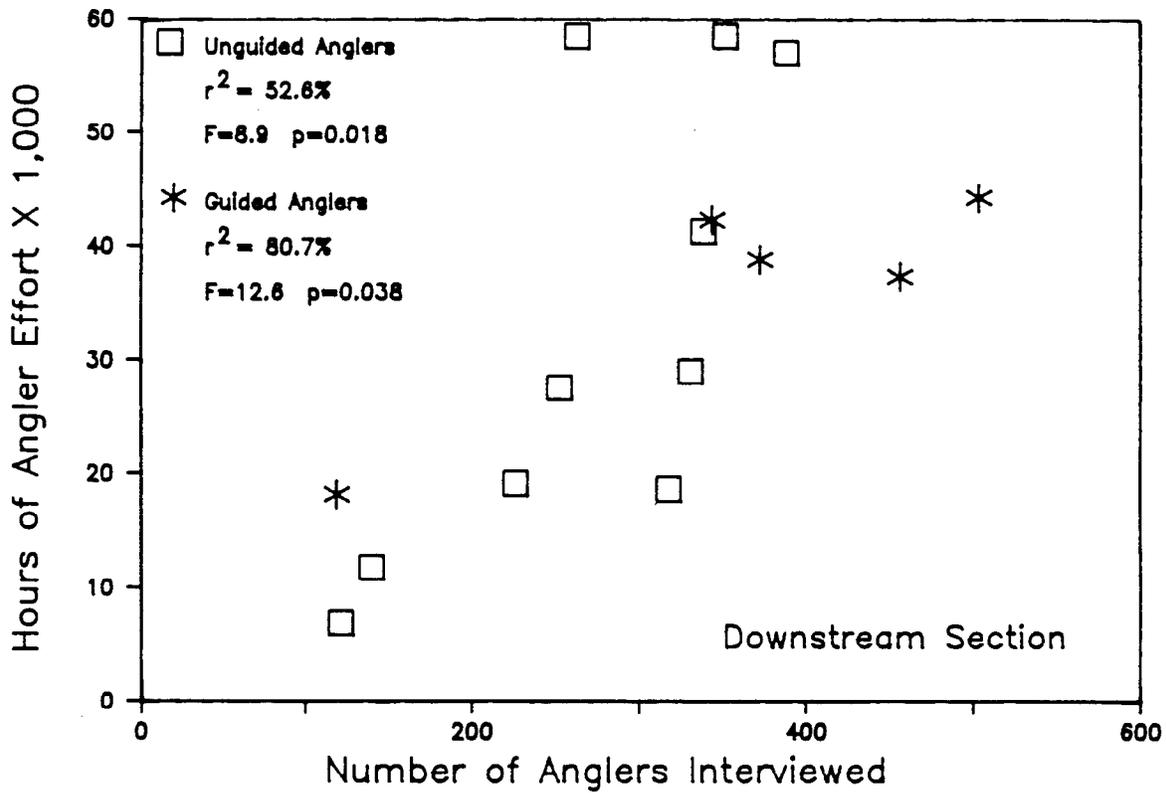
Appendix E4. Regression analysis of consecutive angler counts in the Kenai River chinook salmon fishery, weekday unguided periods (B vs D), guided periods (A vs B), 1989.



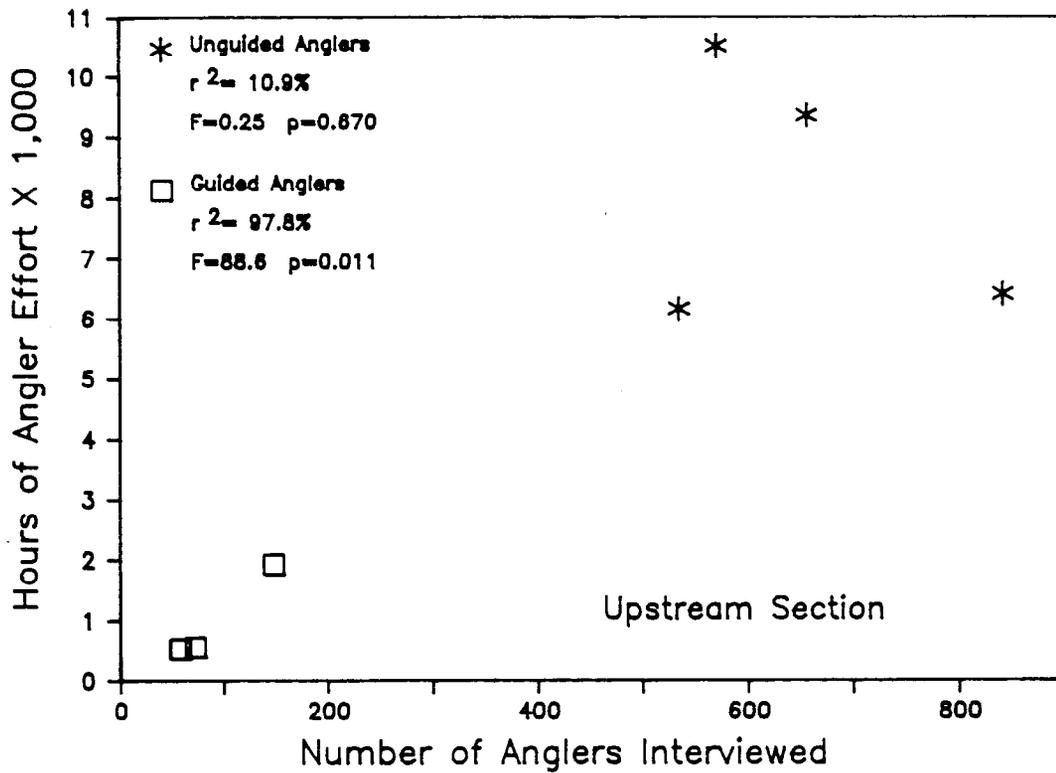
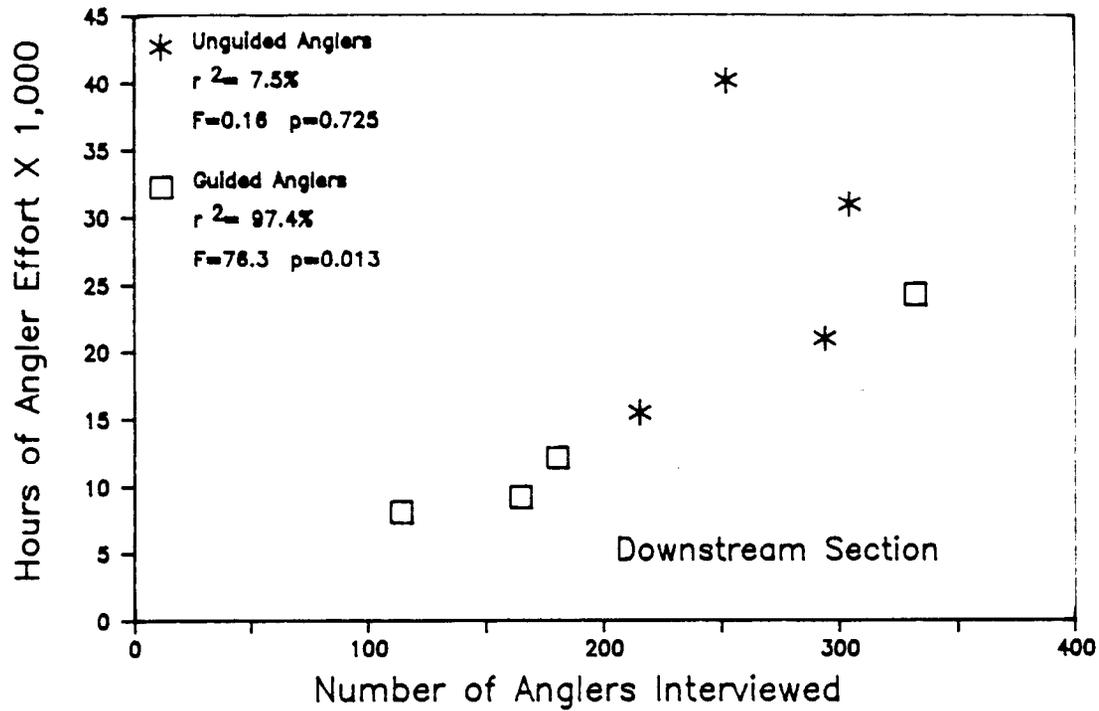
APPENDIX F

Regression analysis of the number of anglers interviewed  
versus the estimated effort by strata  
in the chinook and coho salmon fisheries on the Kenai River, 1989.





Appendix F1. Number of unguided and guided anglers interviewed during each stratum versus the effort estimated for the stratum in the downstream section during the Kenai River chinook salmon fishery, 1989.



Appendix F2. Number of unguided and guided anglers interviewed during each stratum versus the effort estimated for the stratum in the downstream and upstream sections during the Kenai River coho salmon fishery, 1989.